ABSTRACT

Title of dissertation: FAMILY VALUES: ASSESSING RECIPROCAL EFFECTS ON LONGITUDINAL CHANGE IN CHILDREN'S AND PARENTS' VALUING OF MATH AND SPORTS

Lara Turci Faust, Doctor of Philosophy, 2021

Dissertation directed by: Professor Emeritus Allan Wigfield
Department of Human Development and Quantitative Methodology

In the present study I investigated the bidirectional influence that children's and parents' task values in math and sports have on change in the task values of the other group from first grade to 11th grade. Using latent change score models, I found that fathers' math value both positively and negatively influenced change in children's math values from first grade to 11th grade, and children's values both positively and negatively influenced change in both mothers' and fathers' math values from first grade to 11th grade, consistent with my hypotheses and some prior research. However, mothers' math value did not impact change in children's math value during the study period. In addition, both mothers' and fathers' sports values positively influenced change in children's sports value, and children's sports value positively influenced change in both their mothers' and fathers' sports values. Findings in the sports domain indicated differences in how mothers' and fathers' values shape change in children's values; namely that mothers have smaller but consistent effects whereas fathers have larger effects that occur during educational transitions. Supplementary analyses also suggest that children's perceptions of their parents' values in math and sports consistently and positively influence children's own change in values from first grade to sixth grade. Possible explanations for these findings, as well as broader theoretical implications are discussed.

FAMILY VALUES: ASSESSING RECIPROCAL EFFECTS ON LONGITUDINAL CHANGE IN CHILDREN’S AND PARENTS’ VALUING OF MATH AND SPORTS

by

Lara Turci Faust

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Advisory Committee:

Dr. Allan Wigfield, Chair
Dr. Gregory Hancock
Dr. Patricia Alexander
Dr. Geetha Ramani
Dr. Dennis Kivlighan

Dedication

To Emmy. My darling girl.

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Chapter 1: Introduction

Statement of Problem

Decades of research shows that individuals' subjective task values—their perception of the importance and usefulness of a domain, as well as their interest in that domain—for math and sports have significant implications for their intentions and actual decisions to persist at related activities, such as enrolling in advanced math courses, engaging in sports activities, or choosing a college major (e.g., Bong et al., 2012; Dempsey et al., 1993; Musu-Gillette et al., 2015). However, studies mapping the developmental trajectories of children's valuing of both these domains show declines in children's values first through 12th grade, with math value declining rapidly during the high school years (Jacobs et al., 2002; Petersen & Hyde, 2015). Given that children's task values relate to important achievement-related outcomes in both academic and leisure domains, it is critical to investigate what factors influence the downward development of children's valuing of both math and sports over the school years. As will be described in more detail below, expectancy-value theorists (Eccles, 1993; Eccles (Parsons) et al., 1983) argue that children's perceived value for different domains develops through socialization with important adults and the surrounding cultural context. Of the various socializing agents, parents are regarded as the most critical socializers for shaping and navigating children's task values and choices from elementary through high school (Eccles, 1994).

Although several recent studies have linked parents' valuing of certain domains to their children's task values over time (e.g., Gniewosz & Noack, 2012b; Harackiewicz et al., 2012; Lazarides et al., 2017), no study to date has examined how the magnitude of influence that parents' values have on children's own values fluctuates across different periods of children's social and motivational development that occur over the school years. It is likely that parents play different roles as socializers in molding their children's experiences as the children progress through different phases of interest and expertise in different activities. For instance, parents may initially encourage younger children to sample various activities. However, as children age, parents may change their involvement and behaviors to help children develop a specialty in one or two domains as it becomes clearer at which activities children excel or really like (Côté & Hay, 2002). Further, evidence suggests that parents' influence, when compared to that of peer groups and teachers or coaches, on children's academic and sports choices and motivation may wane as children grow into adolescence (Anderssen et al., 2006; Brown, 2004; Fredricks & Eccles, 2004). Finally, although work has explored how parents' values predicted children's future valuing of different domains, it is also possible that parents' values relate to subsequent *change* in children's values over the school years. Such an effect could mean that parents' values play an important role in the downward trajectory of children's valuing of math and sports from elementary through high school. The first purpose of the proposed study was to investigate these relations and determine their stability over the school years.

The proposed study also explored potential differences in the influence of mothers and fathers for their sons and daughters. There is a growing body of research showing that mothers and fathers differ in their socializing behaviors and often also hold different beliefs and attitudes about their children (see Cabrera et al., 2014; Cabrera et al., 2007; Frome & Eccles, 1998; Grusec & Davidov, 2010; Yee & Eccles, 1988). Although mothers tend to spend more time overall interacting with their children, fathers devote a greater allotment of their interactions with their children to play (Parke & Buriel, 1998). Thus, fathers may be more important socializers for their children's sports value than for their math value because the nature of their interactions center on active and recreational tasks. There is also evidence to suggest that the strength of parents' influence on their children's task values may be a function of parent-child gender dyad. Some researchers found that parents' values are more important to children when they are of the same gender (e.g., Gniewosz & Noack, 2012a; Lazarides & Watt, 2017). Others found that mothers are more influential for female-typed domains and fathers for male-typed domains (e.g., Leaper et al., 2012; Viljaranta et al., 2015). Importantly, the above work has primarily focused on academic domains. The second purpose of the proposed study was to investigate the unique impact of mothers' and fathers' values on changes in children's valuing of math and sports to identify potential differences in the socialization of these two domains.

A third major purpose of this study was to examine how child gender may impact the relation between their values and those of their parents. Prior work suggests, for example, that gender-role stereotypes may shape the activities that parents value for their children. In domains that a given culture typically views as masculine, such as math and sports (see Gunderson et al., 2012, for review), parents' gendered beliefs and behaviors can influence girls' and boys' sense of belonging in those domains, which also can influence the value that they place on related activities (see Eccles, 2005). Gendered messages about the value of different activities have particularly important implications for girls' valuing of male-typed domains; for example, Weiss and Barber (1995) found that female athletes rated the influence of mothers, siblings, coaches, and friends higher than did male and female non-athletes. In studies of girls' choices related to math, findings indicate that task values were more important for female students than for male students when they aspired to math careers (Watt et al., 2012). Further, elementary school girls show sharp declines in career aspirations and interest in math due to the mismatch between math's male-dominated orientation and their feminine identity (Archer et al., 2010). Given that socialization processes are shaped by cultural and social gender norms (Eccles et al., 1990;

Schoon & Eccles, 2014; Watt & Eccles, 2008), the proposed study aimed to broaden existing research by analyzing the role of children's gender as a moderator of relations between parents' and children's task values.

I chose to investigate the issues just discussed in the domains of math and sports for several reasons: First, both are typically perceived as male-typed domains; this could present interesting gender differences regarding parents' values and influence on their sons versus their daughters. Second, during childhood sports participation is largely voluntary, but students are required to complete at least a few math courses through high school. Further, math skills are necessary in order for children to advance through to higher levels of education. Thus, parents may be more consistently eager to promote and believe in the importance of math for both their sons and daughters, given the centrality of these skills to academic success. By contrast, parents have more influence regarding their (particularly young) children's selection and participation in extracurricular activities like sports. Because the experiences parents provide are highly reflective of their own task values (Simpkins et al., 2015), such involvement in children's sports-related choices may result in stronger relations between parents' and children's values when compared to math. Finally, although math has been extensively studied with regard to gender differences, the proposed study was be one of the few longitudinal investigations of the interrelation of parents' and children's sports values to date.

Theoretical Framework

The overarching theoretical framework of the proposed study is Eccles (Parsons) et al.'s expectancy-value model of achievement-related choices originally developed by Eccles (Parsons) et al. (1983). Eccles and Wigfield (2020) and Wigfield and Eccles (2020) updated and expanded it recently, and renamed it situated expectancy value theory (SEVT). Of particular importance to the proposed study, Eccles (Parsons) and her colleagues developed their theory to explain gender differences in motivation, performance, and choice behaviors, originally in math and science and later in other domains. Eccles (1993) later proposed a more elaborate socialization model that specified more fully the pathways through which parents shape the development of their children's values through their beliefs and behaviors. They proposed that parents' general valuing of different domains, in combination with their beliefs regarding gender-role stereotypes, directly affect their specific valuing of those domains for their children. Parents' general and child-specific beliefs directly impact their subsequent behaviors, which, in turn, affect children's own values (for an overview, see Lazarides et al., 2015). This model also reflects the theoretical perspective that parent-child interactions during achievement-related activities have immediate as well as long-term implications on children's motivational and behavioral outcomes. Such interactions set in motion the important psychological processes that change an individual's motivational trajectory through their impact on subsequent opportunities, learned skills, perceived abilities, and value-related choices over time (Masten & Coatsworth, 1998; Masten et al., 2005).

Importantly, Eccles (1993) and Eccles (Parsons) et al. (1983) proposed that parents' values are filtered through children's perceptions of their parents' beliefs and behaviors. Therefore, the effect of parents' self-reported values may not have as impactful of an effect as children's perceptions of those values on children's own valuing of certain domains. However, few studies have compared the effects of mothers' and fathers' self-reported values to children's perceptions of these values on children's own valuing of different activities across the school years. Thus, the fourth purpose of the proposed study was to address this critical gap in the literature by providing a comparison of the predictive power of parents' self-reported values and children's perceptions of those values for change in children's own valuing of math and sports.

Eccles and her colleagues also proposed that parents' and children's beliefs and behaviors influence each other reciprocally (Bell, 1979; Eccles & Wigfield, 2020; Lerner & Spanier, 1978). Although developmental theorists have highlighted the importance of taking a reciprocal approach to mapping parent-child patterns of influence (Bronfenbrenner & Morris, 2006; Bugental & Johnston, 2000; Pardini, 2008; Rogoff, 2003), the effects of children's beliefs and behaviors on those of their parents have received relatively little attention in the motivation field (Simpkins et al., 2012; Simpkins et al., 2015). The fifth major purpose of the proposed study was to extend previous explorations of the reciprocal impact of parents' values and the values of their children by mapping potential patterns of influence between parents and children through different developmental stages and educational transitions.

SEVT-Based Research on the Relation of Parents' and Children's Math and Sports Task Values

Several longitudinal studies show that parents' valuing of math predicts the value their children attach to math-related activities years later (Harackiewicz et al., 2012; Gniewosz & Noack, 2012b; Hyde et al., 2016). However, other work provides contrary findings for math as well as for sports (e.g., Eccles et al., 1982; Frenzel et al., 2010; Jacobs & Bleeker, 2004; Simpkins et al., 2015). For example, in a comprehensive study that utilized the same dataset that I used in the present study, Simpkins et al. (2015) found that neither mothers' nor fathers' valuing of sports or math for their elementary-aged children were significantly directly related to children's later valuing of those domains. The authors also investigated reciprocal effects models in their investigation and did not find any significant parent- or child-driven effects in either math or sports. There are many important questions regarding parents' socialization of children's valuing of different activities that Simpkins et al. did not address; I examined several of these questions in the proposed study. First, Simpkins and her colleagues explored relations of parents and their children's valuing of math and sports in separate models for mothers and fathers; thus, they were unable to explore whether mothers and fathers' values had unique predictive effects for their children's later values above and beyond the effect of the other parent. Second, they only explored the relation of parents' values to children's values and only over a single year. The present study explored how parents' values predict *yearly change* in children's values as children progress from first through 11th grade. Third, Simpkins et al. did not examine how both parent and child gender impact these relations, which I included as a major focus of the present study.

Finally, Simpkins et al. (2015) focused only on the effects of parents' self-reported valuing of math and sports for their children and did not consider how children's perceptions of their parents' values may have a distinctive effect on children's own values. As discussed previously, Eccles (Parsons) et al. (1983) stressed that socialization processes operate through children's perceptions of their parents' beliefs. Gniewosz and Noack (2012b) tested this idea by exploring multiple paths from German parents' math values to their fifth-grade children's valuing of math. They found that both mothers and fathers' self-reported valuing of math had significant direct effects on children's math values one and a half years later. However, after adding children's perceptions of their mothers' and fathers' task values to the model, the authors found children's perceptions to fully mediate the effects of parents' self-reported values on children's own math values. It is possible that children's perceptions of their parents' valuing of math and sports may more significantly predict children's own values over the school years when compared to parents' self-reported values. The present study aims to address these questions and test this important facet of Eccles (Parsons) et al.'s (1983) theoretical model.

Purpose of the Present Study, Research Questions, and Hypotheses

The present study utilized an existing longitudinal dataset from the Childhood and Beyond (CAB) Longitudinal Project (Eccles et al., 1984) to address the specific research questions outlined below. I chose to use CAB because it is the only longitudinal study in existence that measured mothers', fathers', and children's task values from elementary through high school. The CAB dataset has a cohort-sequential design, meaning that repeated-measure data from overlapping age cohorts are used to estimate common developmental trends or growth curves. The research team followed three cohorts of children and their parents (with children in kindergarten, first grade, and third grade at wave 1) until data from the three cohorts spanned from kindergarten through 12th grade. (Table 1 depicts the overall design of the study, including children's grade level at each wave.) Parents completed questionnaires at waves 1–4 and wave 6. Available parent (mothers and fathers) and child data allowed me to examine the reciprocal effects of parents' and their children's math and sports values on the others' subsequent yearly change in these values from grades one through 11. I further examined whether these relations differed by parent and child gender. Because children's perceptions of their parents' values were measured from children in grades one through six only, I explored how children's perceptions of their parents' valuing of math and sports predicted subsequent yearly change in children's own valuing of these domains across this limited time frame. (I unpack which variables are measured at which time point in more detail in Chapter 3.) Children did not report separately on their perceptions of their mothers versus their fathers. Thus, I aimed to explore if these relations differed just by child gender in this set of analyses. Because there is so little research exploring how these relations might differ according to child gender or parent-child gender dyad, all gender-related research questions were exploratory.

The research questions and hypotheses I addressed in the present study are:

Research Question 1: How does parents' self-reported subjective valuing of math and sports for their children predict subsequent change in children's own subjective valuing of math-and sports, respectively, as children progress from first to 11th grade? This research question is broken into three sub-questions:

RQ1.1: Does the strength of predictive effects that parents' self-reported valuing of math and sports have on subsequent change in their children's valuing of math and sports differ in magnitude from year to year as children progress from first to 11th grade?

RQ1.2: How do mothers and fathers differ in the predictive power that their self-reported values have on change in their children's valuing of math and sports over time?

RQ1.3: Do these predictive patterns differ according to child gender?

Based on Eccles (Parsons) et al.'s (1983) model and related research (e.g., Bois et al., 2002; Eccles, 2007; Gniewosz & Noack, 2012b; Lazarides et al., 2015), I hypothesized that parents' self-reported values significantly predicted change in children's own valuing of math and sports. However, I also predicted that the strength of these relations would wane over time. This hypothesis is based in research showing that parents' influence on children's academic and sports choices and motivation decreases as children enter adolescence (Anderssen et al., 2006; Brown, 2004; Fredricks & Eccles, 2004).

Further, I also anticipated that both mothers' and fathers' self-reported values would have unique predictive effects on change in children's own values in both domains. This hypothesis is informed by parallel findings from other studies on parental socialization of task values that included both mothers and fathers in the same model (e.g., Gladstone et al., 2018).

Research Question 2: Are there child-driven reciprocal effects predicting subsequent change in parents' valuing of math-and sports for their children as children progress from first to 11th grade? This research question is broken into two sub-questions:

RQ2.1: Does the strength of predictive effects that children's valuing of math and sports have on subsequent change in their parents' valuing of math and sports differ in magnitude from year to year as children progress from first to 11th grade?

RQ2.2: Do these predictive patterns differ according to child and parent gender dyad?

Contrary to Simpkins et al.'s (2015) findings, I hypothesized that the present study would show evidence of bidirectional effects between parents' and children's values. I anticipated that this study would obtain different results for several reasons linked to Simpkins et al.'s study design. Namely, their work aggregated children of different grades into their analyses (first, second, and fourth grades at time 1) and limited the exploration of bidirectional relations between parents' and children's values to a year-long study. By contrast, the present study covers a ten-year time span and explores the reciprocal effects of parents' and children's values on subsequent yearly change in the other group's value. It is possible that aggregating children of different ages may have obscured significant parent-child effects at the individual grade level. Further, this analytical method did not take full advantage of the available data and explore how these effects (and potential reciprocal relations) may change over time and across important developmental phases that children experience over the school years. Because there is little information in the literature regarding how these reciprocal effects may change over time, I did not have direct hypotheses for these analyses.

Research Question 3[1]: How do children's perceptions of their parents' valuing of math and sports predict subsequent change in children's own valuing of math and sports as children progress from first to sixth grade?[2] This research question is broken into four sub-questions:

RQ3.1: Does the strength of the predictive effects that children's perceptions of parents' math and sports values have on subsequent change in children's own valuing of math and sports differ in magnitude from year to year as children progress from first to sixth grade?

RQ3.2: Do children's math and sports values predict change in their perceptions of their parents' valuing of math and sports, respectively, from first to sixth grade?

RQ3.3: Do these predictive patterns differ according to child gender?

Based on SEVT and prior research (Gniewosz & Noack, 2012b), I hypothesized that children's perceptions of their parents' valuing of math and sports would predict change in children's own valuing of these domains from first through sixth grade. I also predicted that these effects would wane as children age, paralleling prior hypotheses regarding the predictive power of parents' self-reported values.

Dissertation Contributions

This dissertation study adds critical new information to the literature on the socialization of children's valuing of math and sports by extending current knowledge of the dynamic relations between mothers' and fathers' values and the values of their children across the school

[1] Although the committee recommended dropping this set of research questions, given the value I believed this portion of the investigation would contribute to the present exploration into parent-child socialization of values, I conducted the analyses. Results addressing these research questions will be presented as "supplementary analyses" at the conclusion of Chapter 4.
[2] As noted earlier, in contrast to parents' self-reported data, which spans from first through 11th grade (waves 1–4 and 6) and contains both maternal and paternal responses, child-reported data on their perceptions of their parents' values only spans from first through sixth grade (waves 2–4) and does not distinguish parent gender.

years. First, the present study is the first to date to explore how parents' valuing of math and sports impacts change in children's own valuing of these domains. Such an investigation addresses the potential impact of parents' values on the downward trajectories of children's math and sports values as they progress through school.

Second, I examined potential reciprocal effects of parents' and children's valuing of sports and math over the span of a decade. Previous studies have primarily measured reciprocal effects over the course of one or two years (e.g., Lazarides et al., 2017; Simpkins et al., 2015). Utilizing such expansive longitudinal data allowed me to explore potential fluctuations in patterns of parent-child influence as children move through different developmental phases.

Third, the present study extends the work of Gniewosz and Noack (2012b) by exploring the effect of children's perceptions of their parents' values on change in children's own values in the sports domain. Although Eccles (Parsons) et al. (1983) highlighted that socialization processes operate through individuals' perceptions of others' values, few studies outside of Gniewosz and Noack (2012b) have explored this facet of her theory. Therefore, it is crucial to further compare the impact of these two sources of information for the development of children's own valuing of math and sports.

Finally, this study builds on prior work by using a different kind of modeling technique, latent change score (LCS) analysis. This modeling technique has important advantages over the modeling analyses used in the other longitudinal research in this area. First, LCS analyses allow one to explore how one variable predicts change in another variable across time, while accounting for other sources of change. For example, in this study, prior levels of children's own task value and developmental contributions can be accounted for. Second, LCS models also allow one to address not just if there are predictive relations among constructs, but by what magnitude a construct impacts change in another construct. Through LCS modeling, I can test whether mothers and fathers uniquely contribute to change in children's values and explore patterns of predictive relations over time. Researchers (e.g., Cabrera et al., 2014; Cabrera et al., 2007; Grusec & Davidov, 2010) increasingly have called for investigations of how both fathers and mothers impact children's development in different areas; my study is be among the first to do so regarding the socialization of children's valuing of activities in different domains.

Definition of Terms

Subjective task value. Broadly, task values are defined as qualities that influence whether or not individuals see a task as worthwhile (Wigfield & Eccles, 1992). Eccles et al. distinguished different sub-components of task value: Individuals' perceptions of how much they are interested in a task (intrinsic value), find a task to be useful (utility value), feel that a task is important to them (attainment value) or what an individual has to give up in order to do a task (cost; Eccles [Parsons] et al., 1983; Eccles, 2005). Eccles (Parsons) et al. (1983) conceptualized values as subjective beliefs, because children assign different values to the same activity. They further emphasized that values are beliefs about specific tasks or domains (also see Wigfield et al., 2016; Wolters & Pintrich, 1998).

Perceptions of task value. I often refer to children's *perceptions* of their parents' values, which Eccles defines as subjective interpretations of parents' attitudes and behaviors rather than reality. Eccles (Parsons) et al. (1983) emphasized that socialization processes operate through individuals' perceptions of others' value expression, which is the intentional or unintentional manifestation of values, such as encouraging a child to play sports, lecturing about the importance of math, etc.

Chapter 2: Literature Review

As outlined in Chapter 1, work in the literature on parent's socialization of their children's achievement motivation suggests that parents' task values—as well as children's perceptions of them—have important implications for the development of their children's task values in both academic and leisure domains. Yet we are just beginning to understand how parents' valuing of math and sports impacts children's own valuing of those domains—and vice versa—over the school years. This is despite evidence showing that children's task values are particularly important for their intentions in addition to their actual decisions to persist at different activities, such as enrolling in advanced math courses, engaging in sports activities, or choosing a college major (e.g., Bong et al., 2012; Dempsey et al., 1993; Musu-Gillette et al., 2015). The present study examined the reciprocal influence of parents' and children's math and sports values on subsequent change in the others' values throughout the school years. In this chapter, I discuss the research—based in Eccles (Parsons) et al.'s (1983) expectancy-value framework—regarding parental socialization of children's values in these domains and focuses, in particular, on the role of parent and child gender within the socialization process.

The chapter is organized as follows: First, I discuss Eccles (Parsons) et al.'s (1983) model of achievement-related choices and Eccles' (1993) parental socialization model that provides the theoretical basis for much of the work on how parents' influence children's task values. Second, I address the parental socialization of children's values, including recent research exploring how parents' math and sports values directly influence those of their children in addition to reciprocal relations between parents' and children's values. Third, I provide an overview of how both parent and child gender impact the socialization process, including the impact of parents' gender-role stereotypes in addition to the differential impact of mothers and fathers for their male and female children. Fourth, I discuss work that highlights the importance of including children's perceptions of their parents' valuing of math and sports in investigations of task value socialization. Finally, I describe how the present study contributes to extant work.

Eccles et al.'s Expectancy-Value Theory (SEVT)

As described in Chapter 1, expectancy-value theory as devised by Eccles (Parsons) et al. (1983) explains how children's motivational beliefs and values and a variety of other influences impact their motivation to pursue achievement tasks and their performance on those tasks (see Figure 1; also see Eccles, 2005; Eccles & Wigfield, 2020; Wigfield et al., 2016). Eccles (Parsons) et al. initially developed expectancy-value theory to explore why women were less likely to pursue careers in math and science when compared to their male peers. Researchers have since used the theory to explain motivation and achievement outcomes in both academic and leisure domains. Expectancy-value theory posits that children's motivation to complete an achievement task is determined most directly by their expectancies for success on that task and the attributes of the task that influence an individual's desire to do the task (i.e., task value).

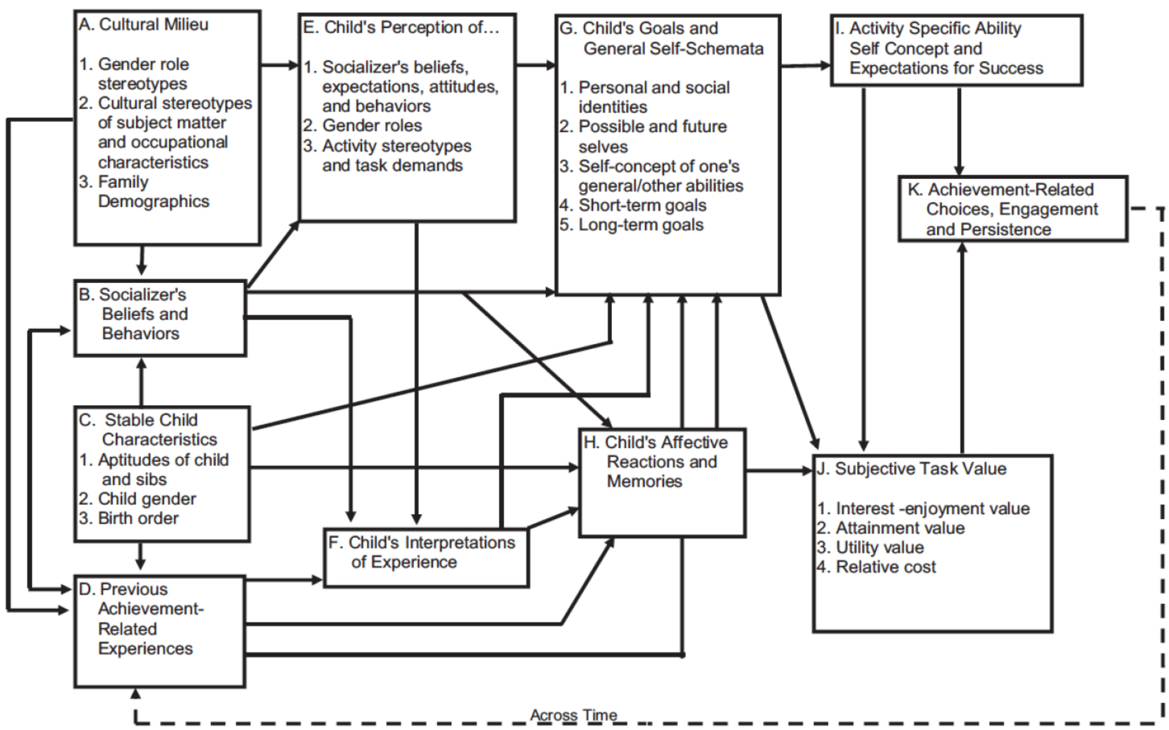
Expectancy-value theory originated with Atkinson's (1957, 1964) expectancy-value model of achievement motivation, which attempted to explain various achievement-related behaviors (see Wigfield et al., 2009, for more detail). Atkinson posited that an individual is motivated to pursue a given task by his or her expected probability of succeeding at the task (expectancy) and the relative attractiveness of this success (value). He proposed that expectancy is inversely related to value, such that individuals assign the greatest value to tasks they perceive as difficult; individuals' motivation was strongest when expectancy and value were at .50 (see Atkinson, 1964; Wigfield & Eccles, 1992, for further discussion of this theory). Eccles et al. expanded and refined Atkinson's theory in several ways (Eccles, 2005; Eccles [Parsons] et al., 1983; Wigfield & Eccles, 2002). First, Atkinson primarily conducted experimental studies in laboratory environments and, thinking he had captured motivation in all settings, generalized his findings to real-world achievement situations. By contrast, Eccles and her colleagues applied their model entirely to real-world achievement situations and primarily utilized non-experimental research approaches. Second, they posited expectancies and values to be positively, rather than inversely, related to each other, such that children who believe that they can do well on a task often also value it more (Eccles & Wigfield, 1995; Jacobs et al., 2002; Meece et al., 1990; Wigfield et al., 1997). Eccles et al. made this change due to the proposed differences in laboratory versus real-world achievement situations (Wigfield & Eccles, 1992; Wigfield et al., 1997). Finally, they defined both expectancy and value components in richer ways, and linked them to a broader array of distal psychological, social, and cultural determinants. I will expand further on these definitions later in this section.

Figure 1 depicts the latest version of Eccles (Parsons) et al.'s model (Eccles & Wigfield, 2020), which as mentioned in Chapter 1 now is called situated expectancy-value theory (SEVT). Individuals' expectancies and values directly affect their achievement-related choices and performance. Children's expectancies and values not only influence one another, but they also are shaped by their achievement goals and general self-schemata, along with their affective memories of previous achievement-related experiences[3]. These factors are influenced not only by

[3] It is important to note that expectancies and values are shaped through some of the same processes and thus do not develop independently from each other (see Trautwein et al., 2012; Wigfield et al., 2020). A number of reviews provide detailed discussions of the developmental trends (e.g., Eccles & Midgley, 1989; Eccles et al., 1998; Wigfield & Eccles, 2002) and socializing influences of expectancies (e.g., Simpkins et al., 2015), as well as how expectancies relate to the development and socialization of task values (e.g., Simpkins et al., 2015; Wigfield et al., 2006, 2009).

Figure 1

Eccles (Parsons) et al.'s (1983) Expectancy-Value Model of Achievement Choices



children's own interpretations of their achievement-related experiences, but also by their perceptions of socializers' beliefs, attitudes, and expectations for them. A host of influences in children's social and cultural surroundings also shape their perceptions and interpretations. These include the beliefs and behaviors of important socializers (namely, parents and teachers), children's specific achievement-related experiences and aptitudes, as well as the implicit or explicit gender and cultural stereotypes contained within their cultural environment. Finally, although Eccles (Parsons) et al. (1983) hypothesized that the direction of influence is from left to right, newer versions of the model also show dashed arrows leading from the far right to the far left of the model, highlighting that these processes are iterative over time (Eccles & Wigfield, 2020).

Definitions of SEVT Constructs

Eccles (Parsons) et al. defined expectancies for success as children's subjective beliefs about how well they will do on a specific task in the immediate or long term future (Eccles & Wigfield, 2002). Eccles et al. considered individuals' expectancies for success and their self-concept of ability as conceptually different. They defined one's self-concept of ability as beliefs about their competency in a given domain, whereas expectancies for success refer to specific upcoming tasks; and the former is posited to determine the latter (see Figure 1). However, Eccles et al. found that self-concept of ability and expectancies for success are highly correlated or even factor together by middle childhood. Thus, subsequent research using the expectancy-value framework collapsed these constructs (e.g., Eccles & Wigfield, 1995; Eccles et al., 1993).

Eccles (Parsons) et al. defined values with respect to the qualities of different tasks and how these qualities influence a child's desire to do the task (Eccles, 2005; Eccles [Parsons] et al., 1983; Wigfield & Eccles, 1992). Similar to expectancies, Eccles (Parsons) conceptualized values as being about specific tasks or domains (also see Wigfield et al., 2016; Wolters & Pintrich, 1998). For example, particular qualities of math-related tasks may influence a child's desire to engage in that task that differ from the qualities of sports-related tasks. In addition, they posited values as subjective, because children assign different values to the same activity. For example, while math bingo may cause some children to become more interested in multiplication, other children may perceive the activity as dull.

Children's overall subjective task value consists of four major components: Attainment value, intrinsic value, utility value, and cost (see Eccles, 2005; Wigfield et al., 2017, for a more detailed discussion of these components). Building on Battle's (1966) work, Eccles defined *attainment value* as the extent to which an individual finds the task to be personally important or meaningful. Eccles (2005, 2009) further expanded this definition by linking of attainment value to individuals' sense of identity. Individuals perceive certain tasks as important when engaging in that task allows them to express or confirm aspects of their personal identity. Thus, attainment value of various tasks is determined by the ability of these tasks to contribute to individuals' perceptions of their real and ideal selves, including (a) conceptualizations of one's personality and capabilities; (b) one's long-term goals and plans; (c) one' schema regarding societal norms (e.g., gender and ethnic norms); (d) one's instrumental and terminal values (Rokeach, 1973); and (e) one's goal orientations (Eccles, 2005, 2009).

Intrinsic value (also referred to as interest value in many studies) is the enjoyment one experiences from engaging in a task. When children intrinsically value an activity, they often can persist at it for a significant period of time. Although this component of task value is conceptually similar to other constructs, such as interest (Hidi, 1990; Hidi & Renninger, 2006; Schiefele, 2009), flow (Csikszentmihalyi, 1988), and intrinsic motivation (Ryan & Deci, 2009), key theoretical differences distinguish one construct from another (see Eccles, 2005, for a detailed discussion of the similarities and differences between these constructs).

Utility value refers to how useful a particular task is with respect to an individual's future plans or personal goals. Eccles (2005) notes that utility value shares qualities with a number of other constructs. For example, it is similar to extrinsic motivation in that, when a task is perceived as useful, it is something you do in order to achieve a future goal (see also Ryan & Deci, 2009). However, because a task that is perceived as highly useful also can reflect important and deeply-held personal goals (e.g., following a certain vocation), utility value overlaps in many ways with attainment value.

Finally, *cost* refers to any perceived negative consequences of engaging in a particular task, such as the effort needed to complete the task, anxiety and negative emotional experiences associated with a task, and the opportunity costs of choosing one activity over another (Eccles, 2005; Eccles & Wigfield, 2002; Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). Eccles and her colleagues presumed that all choices contain associated costs because individuals have limited time and energy to devote to different activities. Because the existing dataset that I utilized for the present study does not contain measures of cost, I will not expand further on this construct.

Developmental Change in Children's Valuing of Math and Sports

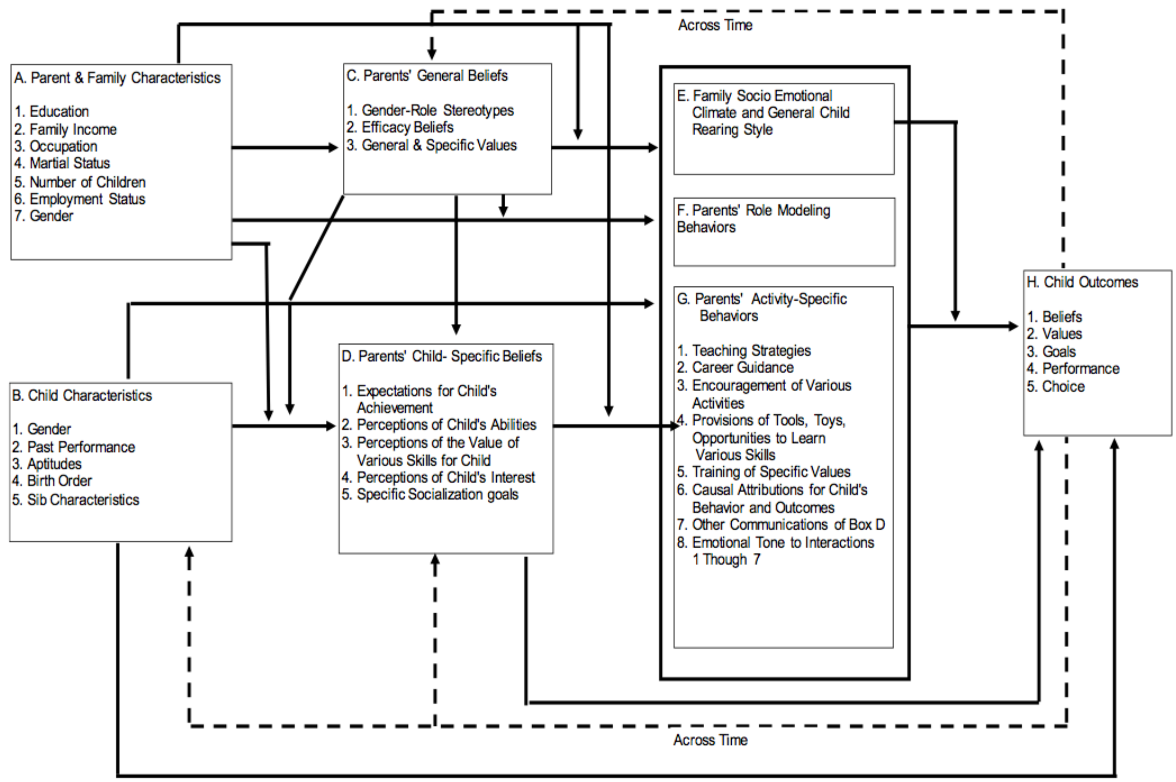
A large number of longitudinal studies in multiple countries (e.g., United States, Australia, Germany) have explored mean-level change in children's math and sports values and show consistent patterns in these domains (see Eccles & Midgley, 1989; Eccles et al., 1998; Wigfield & Eccles, 2002, for reviews). Children's valuing of math and sports-related tasks were found to decline across their elementary school years (Wigfield et al., 1997) and through secondary school (Chouinard & Roy, 2008; Frenzel et al., 2010; Gottfried et al., 2007; Jacobs et al., 2002; Köller et al., 2001; Watt, 2004). However, researchers also found that the rates and shapes of decline for children's values varied across the two domains and by grade level. For example, Jacobs et al. (2002) found that children's sports values declined at a steady rate across the school years. By contrast, children's valuing of math declined most rapidly during their high school years.

This research shows significant gender differences in children's valuing of sports from elementary school through high school (Fredricks & Eccles, 2002, 2005; Jacobs et al., 2002; Wigfield et al., 1997). Jacobs et al. (2002) also found that boys valuing of sports declined more rapidly than girls' values from first through 12th grade. In math, however, researchers have found that girls and boys value math equally from elementary through high school (e.g., Frenzel et al., 2007; Gaspard et al., 2014; Meece et al., 1990; Petersen & Hyde, 2015; Watt et al., 2006; Wigfield et al., 1997) with no gender differences in the rate or shape of decline throughout the school years (Fredricks & Eccles, 2002; Jacobs et al., 2002).

Researchers have given several possible explanations for these declines in children's valuing of different activities, most of which highlight the psychological and experiential factors that help shape children's motivation (see Wigfield et al., 2006, 2009, for reviews). However, work using Eccles (Parsons) et al.'s (1983) framework indicates the critical influence of important socializers, particularly parents, in shaping children's achievement-related motivation and behavior (see Simpkins et al., 2015, for review). Eccles argues that learning and development involve an interchange between a person and his or her social environment, and that parents' beliefs impact not only their parenting practices but also serve to influence children's beliefs and behaviors (Eccles, 1992; Eccles [Parsons] et al., 1983). As previously discussed, parents provide children with feedback as to the importance of certain academic domains and the usefulness of different activities for their future, which can directly influence children's own valuing of those activities and domains (Wigfield et al., 2006). Further, several studies have found that, while children also spend a significant portion of their time with their teachers, children's motivational beliefs and values are more consistently and closely tied to those of their parents (e.g., Jacobs & Eccles, 1992; Marsh & Craven, 1991; Wigfield et al., 1997).

Figure 2

Eccles' (1993) Model of Parental Influence on Children's Achievement Related to Self-Perceptions, Values, and Behaviors



Parental Socialization Model

Building on her original model, Eccles (1993) later proposed an extended model of parental socialization (Eccles, 1993; Jacobs & Eccles, 2000) that focused more fully on specific pathways through which families, and parents in particular, shape the development of their children's achievement-related self- and task-perceptions through various beliefs and behaviors. Figure 2 depicts the most recent version of the model.

Although Eccles (Parsons) et al. (1983) originally drew their model in a primarily linear fashion with a proposed causal sequence from parents to children, the dashed lines in Eccles' parent socialization model (Eccles, 1993; Jacobs & Eccles, 2000) indicate support for the premise that parent-child socialization of children's motivational values is a dynamic process in which both parents and children participate (Bell, 1968; Eccles & Wigfield, 2020; Lerner & Spanier, 1978). Developmental theorists (Bell, 1968; Bronfenbrenner, 1979; Lerner & Spanier, 1978; Pardini, 2008; Sameroff, 1975) have long emphasized that interactions between parents and their children are bidirectional, proposing that children play an active role in eliciting their parents' reactions through their behaviors. Following the reciprocal effects model (Bell, 1968; Lerner & Spanier, 1978; Sameroff, 1975), parent-child interactions can be understood as dynamic processes that are both parent- and child-driven (Kerr et al., 2010). Whereas parent-driven effects involve parents' beliefs and behaviors influencing or inhibiting their children's beliefs and behaviors, by contrast, child-driven effects entail that children's beliefs and behaviors affect their parents' beliefs and behaviors.

Only a few longitudinal studies, however, have examined whether parents' and children's values affect each other reciprocally over time (e.g., Lazarides et al., 2017; Simpkins et al., 2015). Their findings show that parent-driven effects shape the relationship between parents' and children's valuing of math and sports more strongly than child-driven effects for elementary and middle school-aged children (Simpkins et al., 2015) as well as for adolescents (Lazarides et al., 2017). Simpkins et al. (2015) explained their findings by noting that the high degree of stability in parents' valuing of math and sports made it unlikely that they would be influenced by children's own valuing of these domains.

The socialization processes contained in Eccles' (Eccles, 1993; Eccles & Wigfield, 2020; Eccles [Parsons] et al., 1983) model are consistent with aspects of other socialization models. In his ecological theory, Bronfenbrenner (1986; Bronfenbrenner & Morris, 2006) also highlighted that parent-child interactions take place in a larger social context that not only influences what occurs in these interactions but also the implications they have on children's beliefs and behaviors. The model also corresponds with Masten et al.'s (Masten & Coatsworth, 1998; Masten et al., 2005) theoretical perspective that parent-child interactions have immediate as well as long-term implications on children's motivational and behavioral outcomes. This is because these experiences set in motion psychological processes that change an individual's developmental trajectory through their impact on subsequent opportunities, learned skills, perceived abilities, and value-related choices over time.

Parental Influence on Children's Math and Sports Task Values

Prior research has found two factors in Eccles' (1993) parent socialization model to have the strongest influence on children's subjective task values: Parents' general beliefs (e.g., general valuing of academic and leisure domains, gender-role stereotypes) and their beliefs regarding their values specifically for their children (Simpkins et al., 2015). Turning to parents' more specific beliefs about their children, according to Eccles (Parsons) et al. (1983) and Eccles (1993), parents communicate their valuing of certain domains for their children through conversations, activities, and/or the provision of materials and tasks to their children (Jacobs & Bleeker, 2004; also see Simpkins et al., 2015, for a detailed review), thus influencing children's own task values.[4] Recent research has demonstrated that parents' valuing of math directly impacts the value their children attach to these domains. For example, Harackiewicz et al. (2012) and Rozek et al. (2014) implemented comparable interventions intended to influence tenth and

[4] Parents' beliefs regarding their children's math and sports ability also has been found to directly relate to children's reports of math and sports interest and importance from elementary school through adolescence (Andre et al., 1999; Eccles & Jacobs, 1986; Fredricks & Eccles, 2002, 2005; Frome & Eccles, 1998; Hyde et al., 2016; Lazarides & Watt, 2017; Viljaranta et al., 2015; Wigfield et al., 1997).

11th grade American students' perceptions of the utility value of math and science by promoting parents' perceptions of math and science utility in randomized field studies. They both found that the intervention increased mothers' STEM utility value, which directly related to an overall increase in children's future STEM value. Hyde et al. (2016) found that the extent to which American mothers, in a hypothetical scenario, would elaborate and make personal connections when talking with their children about the utility of STEM subjects in ninth grade predicted their children's STEM interest and utility value in 12th grade. Frenzel et al. (2010) found German parents' valuing of math to be related to children's average levels of math interest from fifth to ninth grade; however, parents' math value was unrelated to the rate of change of children's math interest. By comparison, there have been very little work investigating parental influences on the development of children's sports. A comprehensive study by Simpkins et al. (2015) is the only study to date to expand this work to the domain of sports, but found that neither mothers' nor fathers' valuing of the domain were significantly related their children's valuing of sports a year later.

Despite the findings that support Eccles' proposal that parents' values can directly impact the values of their children, the literature also reflects a number of mixed findings in this area of research. Several studies using American samples failed to find a significant direct relation between parents' perception of importance and children's interest in or utility of math (Eccles et al., 1982; Jacobs & Bleeker, 2004). And, paralleling her findings in the sports domain, Simpkins and her colleagues (2015) also found, using an aggregated measure of task value, that parents' values had no direct relation to the values of their children in math. Work that incorporates other factors into the investigation of how parents' and children's math and sports values relate shines some light on why the literature reflects such mixed results. First, I will discuss how parent and child gender impact the socialization process and second, I will address the importance of considering children's perceptions of their parents' values as opposed to parents' self-reported values.

The Role of Parent and Child Gender on the Socialization of Children's Task Values

One reason for the mixed findings regarding the direct effect of parental values on children's values is differences according to parent and child gender. For example, Lazarides and Ittel (2013) showed that when secondary students perceived their parents to value and enjoy math, this significantly predicted math interest, but only for girls. Providing a more nuanced picture are the few studies that examined how both parent and child gender moderated the relations examined in their investigations. In a cross-sectional study, Gladstone et al. (2018) found that German mothers' perceptions of math utility for their fifth through 12th grade children were significantly positively associated with girls' and boys' own utility values. Fathers' perceptions, however, only were significantly associated with girls' own utility values and not those of boys. By contrast, Gniewosz and Noack (2012a) found that German mothers' and fathers' math values had significant and unique positive effects on their fifth-grade boys' and girls' valuing of math over a year later. However, additional person-centered analyses revealed two classes or groups of children. In Group 1, only maternal valuing of math predicted children's own math values, while in Group 2 paternal valuing of math was the only significant predictor. The authors found that child gender, not parental school involvement or parenting styles, predicted group membership. Girls were more likely to be found in Group 1, where only maternal transmission effects were shown and boys were more likely to be in the group showing paternal effects only (Group 2). However, the relatively small effect ($r = -.24$) indicated that class membership is not entirely explained by child gender. I will address the competing theories for why mothers or fathers may be more important for girls or boys in male-typed domains like math and sports later in this chapter.

Researchers have long been interested in how parents may socialize their sons and daughters differently. Several studies have addressed how the socialization of children's task values may differ according to both parent and child gender (e.g., Fredricks & Eccles, 2005; Simpkins et al., 2015). Because socialization processes are shaped by cultural and social gender norms (Eccles et al., 1990; Schoon & Eccles, 2014; Watt & Eccles, 2008), parents' task values for their children and related behaviors are shaped by gender-role stereotypes regarding the domains to which parents believe boys and girls are inherently best suited. These beliefs and behaviors may carry particular importance in domains commonly stereotyped as being either masculine (e.g., math, sports) or feminine (e.g., English, music; see Gunderson et al., 2012). Several studies also suggest that parent gender is important for the socialization of children's valuing of both academic and leisure domains (e.g., Gladstone et al., 2018; Gniewosz & Noack, 2012a; Lazarides & Watt, 2017; see further discussion below). Some researchers argue that children are more likely to adopt a parent's values when they are of the same gender (e.g., Lazarides & Watt, 2017). Others suggest that mothers are more influential for female-typed domains and fathers for male-typed domains (e.g., Leaper et al., 2012; Viljaranta et al., 2015). The following sections will review findings that support each of these two theories regarding the importance of parent and child gender and the associated implications for the development of children's values.

Gendered Socialization Processes

As discussed previously, Eccles (1993) posited that parents' child-specific beliefs regarding the value of certain domains for their children are shaped, in part, by more general beliefs, such as social gender-role stereotypes. Parents transmit gendered beliefs and values to their children through explicit communication of their stereotyped beliefs as well as through their parenting behaviors (Bleeker & Jacobs, 2004; Eccles et al., 2000; Eccles & Jacobs, 1986; Fredricks & Eccles, 2002; Jacobs, 1991; Jacobs & Bleeker, 2004; Tiedemann, 2000). Indeed, research shows that parents perceive math and sports to be less important for girls versus boys (Crowley et al., 2001; Fredricks & Eccles, 2005; Gladstone et al., 2018; Hyde et al., 1990; Simpkins et al., 2015; Tenenbaum & Leaper, 2003; Wang & Degol, 2014). Interestingly, several studies show that mothers and fathers do not differ in their gendered math and sports values that favor boys over girls (e.g., Fredricks & Eccles, 2005; Gladstone et al., 2018). Findings also indicate that parents' gendered values become manifest in parents' behaviors when interacting with their children during achievement activities. For example, parents often provide experiences for their children that fit cultural gender norms (e.g., dollhouses for girls, chemistry sets for boys) and activities (e.g., cooking for girls, football for boys) (Eccles, 1993; Jacobs et al., 2005; Jodl et al., 2001). In studies by Jacobs et al. (Jacobs & Bleeker, 2004; Jacobs et al., 2005), mothers of children in first to sixth grade reported that they purchased significantly more math and science items for sons than for daughters during the past year. Other studies demonstrated that girls already perceive less encouragement from parents to participate in math activities by elementary school (e.g., Rice et al., 2013).

Much of the work on how parents' gendered stereotypes impact children's valuing of math and sports is fairly dated (e.g., Eccles & Jacobs, 1986; Jacobs, 1991). It is quite possible that stereotypes regarding boys' and girls' suitability for participation in math and sports have evolved since researchers conducted those studies. However, findings from recent research (e.g., Gladstone et al., 2018; Tomasetto et al., 2011; Tomasetto et al., 2015) suggest that, still, parents persistently endorse gendered stereotypes regarding both math and sports (also see Gunderson et al., 2012, for review). Parents' expressions of these beliefs may simply have become more implicit over time.

Differences in Maternal and Paternal Influences for Male and Female Children

As was previously discussed, there are conflicting findings regarding the differential roles and influences of mothers versus fathers for their sons and daughters for children's valuing of math and sports. Because the studies that explore this topic have mainly focused on the role of mothers' beliefs and behaviors (e.g., Harackiewicz et al., 2012; Rosek, 2004; Simpkins et al., 2012), less is known overall about the role of fathers for children's motivational development (Simpkins et al., 2015).

Drawing from the literature on differences in the socialization practices of mothers and fathers (Cabrera et al., 2014; Cabrera, et al., 2007; Grusec & Davidov, 2010), several theorists posit competing hypotheses regarding the influence of mothers versus fathers. According to socialization and cognitive theories (Bussey & Bandura, 1984; Maccoby, 1998), children are particularly sensitive to the behaviors of same-gender adults, and are more likely to adopt the beliefs and behaviors of same-gender adults while distancing themselves from other-gender adults. Thus, girls should be more strongly influenced by their mothers than are boys and "motivated to adopt own-sex distinctive behavior" (Maccoby, 1998, p. 153). Several studies support this "gender match" hypothesis (e.g., Gniewosz & Noack, 2012a). As noted in the prior section, Gniewosz and Noack (2012a) found that maternal valuing of math was more likely to predict girls' own math values, whereas paternal valuing of math was more likely to predict boys' own math values. The authors note that these results support assumptions formulated in gender-schema theory (Bem, 1964) that children form gender-linked associations related to society’s cultural definitions of femaleness and maleness. The authors suggest that because children learn to invoke this network of gender-linked associations when evaluating and assimilating new information, the same-gender parent’s values tend to be more salient to children’s own values (Bandura, 1997).

Alternatively, children may view a parent as a better model for a domain based on gender-role stereotypes. That is, children may perceive fathers, who are stereotyped to be more athletic and better at math (Brandell & Staberg, 2008), as particularly important influences within math and sports domains; whereas mothers may be important for more feminine-typed academic domains such as English (Leaper et al., 2012; Viljaranta et al., 2015). Further, fathers’ beliefs regarding math and sports may be particularly impactful for their daughters’ motivational development. McGrath and Repetti (2000) suggest that, given the tendency in Western culture to expect less from girls physically and in the hard sciences, girls may particularly benefit when their fathers—who are cast as role models for these domains—stress their academic and athletic success. Supplementing these conclusions, Gladstone et al. (2018) found that although mothers’ perceptions of math utility for their fifth through 12th grade children were significantly positively associated with both girls’ and boys’ own utility values, fathers’ perceptions only were significantly associated with girls’ own utility values and not those of boys. The limited data on fathers makes it difficult to define the unique roles that mothers and fathers play in the socialization of girls’ and boys’ values. Some studies that do include mothers and fathers in their investigations examine them in separate models so that they could not determine if each parent contribute uniquely to their children’s development of values above and beyond that of the other parent (e.g., Simpkins et al., 2015). Further, likely due to the large sample sizes necessary to conduct such an investigation, there are only a few studies that explore the effects of parent *and* child gender on children's value development (e.g., Gladstone et al., 2018; Gniewosz & Noack, 2012a; Lazarides & Watt, 2017).

Children's Perceptions of Parents' Values

As discussed previously, Eccles (1993) and Eccles (Parsons) et al. (1983) highlighted that children play an active role in the socialization process, which operates through children's perceptions of their parents' beliefs and behaviors. Indeed, recent longitudinal research demonstrates the impact of children's perceptions of their parents' math values for their own valuing of math (Ahmed et al., 2010; Lazarides et al., 2017; Lazarides & Ittel, 2013; Noack 2004). Prior work in this area suggests that, during parent-child interactions, it is the clear and observable expression of parents' values (i.e., through parental behaviors and communications of their beliefs) as well as children's ability to accurately perceive parents' values that facilitates a match between parents' and children's valuing of different domains (see Goodnow, 1997; Kuczynski et al., 1997). The implication of these conditions is that parents may report that they highly value a domain, but if they do not effectively convey these values such that children can accurately perceive them, there may be little relation to children's own valuing of that domain.

Highlighting the importance of measuring children's perceptions, Gniewosz and Noack (2012b) compared the differential effects of parents' self-reported math values versus fifth-grade children's perceptions of their parents' valuing of math for their own math values in a longitudinal study. They found that children's perceptions of their parents' values fully mediated the effects of parents' self-reported values. In addition to the reasoning previously discussed, Gniewosz and Noack (2012b) suggested that differences in the socializing behaviors of mothers and fathers (Cabrera et al., 2014; Cabrera et al., 2007; Grusec & Davidov, 2010) also may have implications for how accurately children perceive their parents' values. They found that children inferred their mothers' values from certain behaviors, such as parental involvement in math, but did not infer their fathers' values from the same behavior. Given these findings, it is critical to compare the effects of mothers' and fathers' self-reported values to children's perceptions of these values on children's own valuing of different activities across the school years. The present study aimed to address this gap in the literature using child-response data from first through sixth grade. In doing so, this work extends knowledge on the mechanisms of value socialization for both academic and leisure domains by comparing the impact of two different sources of information regarding parents' math and sports values for the development of children's own valuing of those domains.

The Present Study

As discussed in Chapter 1, this dissertation study aimed to expand upon work by Simpkins et al. (2015) and Gniewosz and Noack (2012b) in the domains of math and sports. I explored year-by-year differences in the reciprocal impact of parents' and children's values on subsequent change in the others' values from first through 11th grade. By having mothers and fathers in the same model, I hoped to highlight the (potentially) unique predictive roles of mothers and fathers for the development of their children's values, while concurrently exploring whether these relations differ according to child gender. I also explored how children's perceptions of their parents' math and sports values impact yearly changes in children's own valuing of those domains from first through sixth grade.

The study is a secondary analysis that utilized data from the Childhood and Beyond Longitudinal Project (CAB; Eccles et al., 1984) to address these research aims. The CAB dataset is ideal for this study because it is the only longitudinal study in existence that measured both mothers', fathers', and children's task values across the K–12 years. However, it is important to reiterate that this is the same dataset previously utilized by Simpkins et al. (2015). This dissertation study also shares several commonalities with Simpkins et al.'s work, including using the same parent self-reported task value scales and similar child task value scales and exploring reciprocal relations among them. However, the present study expands upon Simpkins et al.'s work in ways that provides a number of unique contributions to the parent socialization literature. These include using a different statistical modeling technique, exploring the unique contributions of mothers and fathers in the same model, expanding the model to explore how the values of one group impact yearly change in the values of another group over the course of a decade, and exploring how children's perceptions of parents' values impact subsequent change in children's own task values from first through sixth grade.

As I will discuss in more detail in Chapter 3, the current study aimed to use four latent change score models (two for each domain) to address my research questions. The first set of models explored two types of effects: Parent-driven, in which mothers' and fathers' self-reported values impact subsequent change in children's values; and child-driven, in which children's values impact subsequent change in their mothers' and fathers' values. These effects were modeled year-by-year from grade one to grade 11. I conducted invariance tests on these effects to explore differences by child gender. The second set of models again explored parent-driven and child-driven effects. However, children's perceptions of their parents' values (which is not gender defined) serve as the source of the parent-driven effects. These analyses, given the available data, only run from first through sixth grade. Additional information regarding the dataset sample and analytical strategy will be discussed in detail in the next chapter.

Conclusion

To conclude, researchers studying achievement motivation suggest that parents' valuing of different domains for their children—as well as children's perceptions of their parents' values—have important implications for the development of their children's own task values. Although a number of studies have found significant relations between parents' and children's valuing of math (e.g., Frenzel et al., 2010; Gniewosz & Noack, 2012b; Harackiewicz et al., 2012; Rozek et al., 2014), little work has explored these relations in the domain of sports (e.g., Simpkins et al., 2015). Mixed findings from studies focusing on math suggests that the relation between parents' and children's task values may vary according to parent and child gender. This evidence parallels work that highlights the differences in the socialization practices of mothers and fathers (see Cabrera et al., 2014; Cabrera et al., 2007; Grusec & Davidov, 2010), and suggests that gendered socialization may lead parents to express and emphasize differential valuing of male-typed domains to their sons and daughters. Other studies that compared the effects of parents' self-reported valuing of math to children's perceptions of their parents' valuing of math on children's own math values (e.g., Gniewosz & Noack, 2012b) revealed that the effects of children's perceptions fully moderated those of parents' self-reports. Although most of these studies were longitudinal, none covered a span of more than one to two years. Further, few explored potential reciprocal effects between parents' and children's values.

In the present study, I explored year-by-year differences in the reciprocal impact of parents' and children's values on subsequent change in the others' values from first through 11th grade. By having mothers and fathers in the same model, I investigated the (potentially) unique predictive roles of mothers and fathers for the development of their children's values, while concurrently exploring whether these relations differ according to child gender. I also explored how children’s perceptions of their parents’ values impact change in children’s own values first through sixth grade.

Chapter 3: Methods

As discussed in Chapters 1 and 2, the present study had three primary research aims that are expressed in the three multi-part research questions and hypotheses. First, I explored how the self-reported math and sports values of parents and their children predict each other's subsequent change in value year-by-year while children progressed from first through 11th grade. Second, I investigated how children's perceptions of their parents' math and sports values might differentially predict change in their own values when compared to parents' self-reported values from first through sixth grade. And finally, the study addressed whether there are potential differences in each of these effects by parent and child gender. In order to explore how these motivational constructs predict each other's change over the school years, a longitudinal dataset that sampled both children and their parents throughout that time was necessary. Therefore, I utilized data from the Childhood and Beyond Longitudinal Project (CAB; Eccles et al., 1984), which followed three cohorts of children and their parents from kindergarten through 12th grade and has a cohort-sequential design. Two of the explicitly stated purposes of CAB were to address the development of children's motivational beliefs in a variety of academic and extracurricular areas and the influence of certain home factors on motivational beliefs (Eccles et al., 1984). Further, CAB is one of the very few longitudinal studies of parents' beliefs and socialization that includes both mothers and fathers. Thus, the dataset is ideally suited to address the questions of interest to the present study both in its longitudinal structure and its focus on social factors predictive of change in children's valuing of different activities.

In this chapter, I describe the CAB sample and data collection procedures. I then discuss relevant measures collected for CAB as they relate to the purpose of this study. Finally, I revisit the research questions of interest for the present study and discuss the specific data analytic plan for each of my research questions.

The Childhood and Beyond Longitudinal Project Dataset

Participants

The CAB dataset includes 987 children (51.2% female), 723 of their mothers, and 541 of their fathers. Families were recruited from 12 public elementary schools in four school districts in the suburbs of a large Midwestern city. The study began in 1987 with children in three cohorts in kindergarten, first grade, and third grade; children first completed questionnaires when they were in first, second, and fourth grades. Seventy-five percent of the families initially recruited in the different schools agreed to participate. Eccles and her colleagues recruited additional children and their families during the second and third year of the study because two additional school districts were added and because siblings were added. Each recruitment year, teachers distributed letters describing the study and permission slips to families, in accordance with the University of Michigan Institutional Review Board, HUM00049773, project title: "Childhood and Beyond Study."

Three of the four recruited school districts were located in medium to large suburban communities, and the fourth was in a medium-sized university city. Each district primarily served White families (95%), but also included a small population of Black, Native American, Asian American, and Latinx families. Annual family income ranged from $10,000 to over $80,000 with a median of $40,000–$49,999. Ninety-eight percent of parents earned a high school degree and 37% held a bachelor's degree. The research team specifically recruited from these school districts so that family income and neighborhood resources would not be obstacles to children's activity participation and course-taking. For example, each district offered gifted or enrichment programs, computer programs, and instrumental music. This allowed for work to investigate the impact of other parent and child factors on children's motivational outcomes and related choices (Simpkins et al., 2015).

Procedures

The CAB dataset has a cohort-sequential design with nine total waves of data collected from 1987 to 1999. Cohort sequential designs—also referred to as accelerated longitudinal designs—link adjacent segments of repeated data from different age cohorts to estimate common developmental trends or growth curves (Miyazaki & Raudenbush, 2000). Table 1 depicts the overall design of the study, including children's grade level at each wave.[5] Most waves were spaced one year apart, with two exceptions: Wave 5 (seventh, eighth, and 10th grade) occurred four years after wave 4 (third, fourth, and sixth grade) due to a funding gap. In addition, waves 8 and 9 occurred when children in the middle and youngest cohorts were in 12th grade.

Children completed questionnaires during the spring of waves 2 through 9 (researchers administered children's physical and cognitive aptitude tests during wave 1). The research team hired substitute teachers in each district to administer the questionnaires in children's school classrooms under project staff supervision, except in wave 6 when questionnaires were mailed to children. Project staff read aloud questionnaire items to the entire class during waves 2 through 4. At waves 5, 7, 8, and 9, the child questionnaires were self-administered in the classroom. Children also completed IQ and athletic ability assessments when they joined the study. Parents completed self-administered questionnaires that researchers mailed to their homes along with a

[5] The majority of CAB Study's target children belong to the three cohorts depicted in Table 1. However, due to augmented and sibling samples, 67 children were included in additional age cohort groups. These children ranged in age from two years younger than the Young cohort and one year older than the Old cohort.

Table 1

CAB data collection schedule for young, middle, and old cohorts

Year	Wave	Grade Level												
		K	1	2	3	4	5	6	7	8	9	10	11	12
1	1^{P}	Y	M		O									
2	2^{P}		Y	M		O								
3	3^{P}			Y	M		O							
4	4^{P}				Y	M		O						
5														
6							No data collected							
7														
8	5								Y	M		O		
9	6^{P}									Y	M		O	
10	7										Y	M		O

Note. (Y) = young, (M) = middle, (O) = old. ^{P} Years that parent data were collected.

stamped, return envelope during the spring of waves 1, 2, 3, 4, and 6. (Simpkins et al., 2015).

The present study utilized multiple waves of CAB data. To address Research Questions 1 and 2—how the self-reported math and sports values of parents and their children reciprocally predict each other's subsequent change in value year-by-year—required both parent- and child-response data. Therefore, the analyses drew from waves 2 through 6.[6] Measures to address Research Question 3—how children's perceptions of their parents' math and sports values and children's own valuing of math and sports reciprocally predict each other's subsequent change year by year—were administered to children from waves 2 through 4.

Measures

Eccles et al. (1984) developed all CAB measures to assess children's and parents' beliefs about the same domains and extensive work across several studies has shown the items to have good psychometric properties (see Eccles et al., 1983; Eccles et al., 1984; Eccles & Wigfield,

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[6] As previously noted, parents did not provide data during wave 5. I will address how I will handle this type of missing data within the discussion of my data analysis plan.

Table 2

Sample sizes and reliabilities of repeated measures for each wave

Indicator	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Math Value					
Fathers	n/a	.69 (362)	.69 (292)	n/a	.59 (256)
Mothers	n/a	.48 (534)	.47 (457)	n/a	.51 (394)
Girls	.56 (438)	.69 (508)	.78 (463)	.87 (361)	.90 (278)
Boys	.66 (424)	.73 (487)	.81 (437)	.87 (344)	.92 (211)
Sports Value					
Fathers	n/a	.76 (361)	.78 (292)	n/a	.79 (255)
Mothers	n/a	.74 (533)	.76 (457)	n/a	.78 (393)
Girls	.70 (356)	.80 (409)	.86 (380)	.88 (314)	.82 (254)
Boys	.68 (348)	.71 (401)	.83 (368)	.90 (314)	.86 (198)

Note. Reliabilities are Cronbach's alpha coefficients. Sample sizes for each wave are in parentheses. n/a indicates when parents completed only a one item assessment (Wave 2) or when information was not gathered from parents (Wave 5).

1995; Eccles, Wigfield, et al., 1993; Eccles [Parsons] et al., 1982). The complete list of measures and the wording of the items contained in the self-report questionnaires to be used in the present study can be found in Appendix A. Internal consistency reliabilities (Cronbach's alpha) for all variables separated by domain, participant group, and wave are shown in Table 2. Unless otherwise indicated, children and parents responded to items using a seven-point Likert scale with anchor terms that differ for each question.

Child-Reported Indicators. The present study used data from child questionnaires, which include information about children's valuing of math and sports as well as their perceptions of their parents valuing of those domains.

Children's Subjective Task Values. The questions about children's subjective task value assessed utility, attainment, and intrinsic value components. One indicator measured the utility value that children assigned to each sports and math from waves 3 through 6. One indicator assessed the attainment value assigned to sports and math from waves 3 through 6. Two questions measured children's interest value in each domain from waves 3 through 6.

Children's Perceptions of their Parents' Subjective Task Values. Children's perceptions of their parents' subjective valuing of math and sports were measured with a single item in waves 2, 3, and 4. The item reflects attainment value in that it asks how important the child believed it was to their parents that they do well in math or sports.

Parent-Reported Indicators. This study also used data from parent questionnaires, which include information about families' demographic characteristics and parents' valuing of math and sports for their children. Mothers and fathers separately reported information on all indicators.

Parents' Subjective Task Values for their Children. Parents' valuing of math and sports for their children described the extent to which they perceived each domain as being important and useful for their child's future (i.e., attainment and utility value). As shown in Appendix A, parents' subjective task values were assessed with a single item at wave 2 and with two items for each domain in waves 3, 4, and 6.

Missing Data

Researchers tracked all subjects and asked them to participate at each wave of data collection. A combination of strategies was utilized to minimize attrition, including mailed surveys and telephone interviews (coupled with a variety of tracking strategies, including parent or friend contacts, the State Motor Vehicle Department records, social security numbers, and forwarding address information available from the post office). The missing data rates in this study are comparable to rates in other longitudinal studies (Simpkins et al., 2015). The rate of missing data for each set of participants was as follows: Wave 2 was 24% for mothers, 36% for fathers, 16% for children; Wave 3 was 31% for mothers, 35% for fathers, 7% for children; Wave 4 was 37% for mothers, 48% for fathers, 14% for children; Wave 5 was 31% for children; Wave 6 was 49% for mothers, 32% for fathers, 49% for children. As is common in all longitudinal studies, attrition often increases with the length of the study. The most common source of attrition was families moving out of the data collection area (Simpkins et al., 2015).

Data Analysis Plan

To address all three of the research questions of interest to the present study, which explored the dynamic relations between parents' and children's valuing of math and sports over time, I used latent change score modeling (LCS; McArdle, 2001, 2009; McArdle & Hamagami, 2001). All analyses used the robust maximum-likelihood estimator in Mplus 7.1, which corrects test statistics and standard errors for non-normality in the manifest variables (Muthén & Muthén, 1998–2012). Following recommendations by Graham (2009), I used full information maximum likelihood estimation (FIML) to account for missing data.

Latent change score modeling is a highly flexible technique that is particularly suited for testing dynamic hypotheses about change within a variable, and about the time-ordered effect of one variable on another (Ferrer & McArdle, 2010; McArdle & Grimm, 2010). The advantage of utilizing this type of modeling procedure is that it combines features of autoregressive cross-lagged structural models and latent growth curve models, the two types of models most commonly used to analyze longitudinal data. Similar to cross-lagged structural models—utilized by Simpkins et al. (2015)—LCS models segment the developmental period into discrete time intervals. This allows the use of time-sequence logic to test the predictive power among constructs (e.g., parental value at time 1 predicts children's value at time 2, controlling for the autoregression of children's value at time 1). Similar to latent growth curve models—utilized by

Simpkins et al. (2010) and Jacobs et al. (2002)—LCS models also are able to estimate growth trajectories over a period of time using means as well as covariances. LCS models were specifically developed to examine dynamic and reciprocal relations among two or more variables across time while accounting for other sources of developmental change (Grimm et al., 2012). Given the different evolving developmental and socialization processes that shape children's task values over time, as discussed in Chapter 2, an LCS model is the perfect approach to examine the present study's research questions.

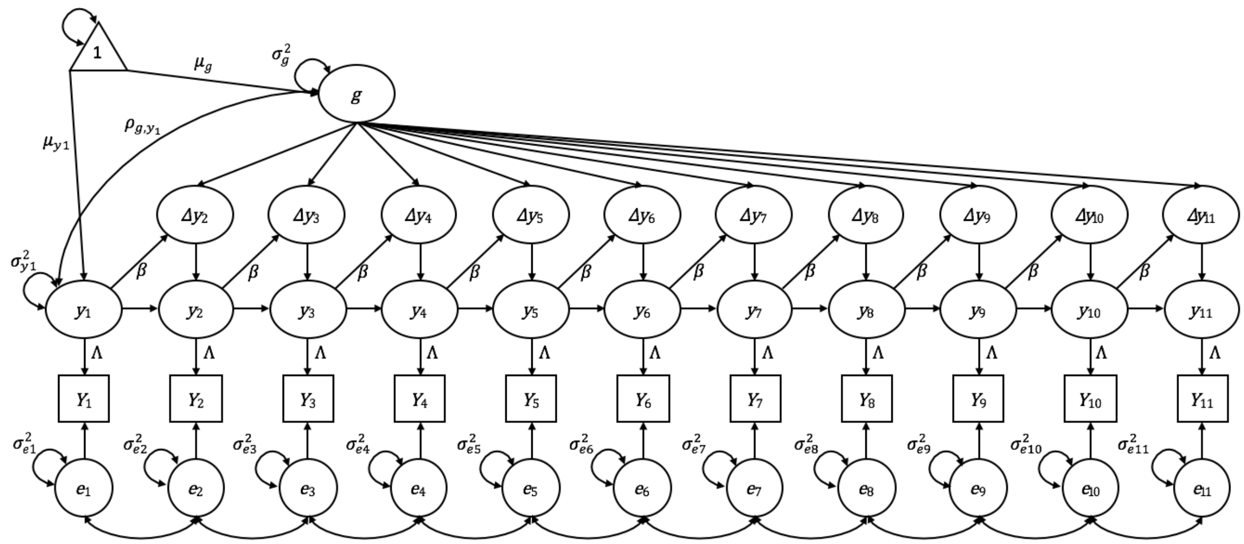
Figures 4 and 5 provide a visual depiction of the LCS models that addressed Research Questions 1, 2 (Figure 4), and 3 (Figure 5). Although the two models contain different variables, the construction and operation of the models are the same. The LCS models in the present study describe average group change over time. Rectangles represent observed or measured variables, ovals represent latent or random variables. One-headed arrows represent directional paths, such as regression coefficients and factor loadings, and two-headed arrows represent non-directional paths, such as covariances (a covariance beginning and ending at the same variable is that variable's variance). Before addressing the full multivariate model, it is helpful to establish the processes that occur within the univariate model of change contained within each group of variables (see Grimm et al., 2016, for a thorough discussion of these processes). Figure 3 depicts a path diagram of the univariate dual change model, where the amount of change between time *t* – 1 and time *t* is a composite of systematic constant change (g_i) from a linear slope and systematic proportional change (β) over time. (I will return to these two parameters later in this section.)

Each observed score is the sum of a latent true score and a residual score

$$Y_{ti} = y_{ti} + e_{ti}$$

Figure 3

Univariate Dual Change Model Representing Change in a Group's Task Value from First Through 11th Grade



where Y_{ti} is the observed score measured at time *t* for individual i, y_{ti} is the latent true score at time *t* for individual i, and e_{ti} is the residual score at time *t* for individual i. While the initial latent true score (y_{1i}) has a mean (μ_{y1}) and a variance (σ_{y1}^2), the following true scores have intercepts and variances fixed to 0. The residual scores are assumed to follow a normal distribution with a mean of 0 and a variance of σ_e^2 ($e_{ti} \sim N(0, \sigma_e^2)$). The residual variance (σ_e^2) is freely estimated at each time point to reduce bias in latent variable variances and covariances (Grimm & Widaman, 2010; Kwok et al., 2007). These models reflect the assumption that the measurement of observed variables is invariant across time, meaning that the psychometric properties of the indicators used to measure individuals' values do not change with repeated measurements. Thus, factor loadings (Λ) and indicator intercepts are constrained to be equal across time points. This constraint separates the latent or true score from the random error of measurement (McArdle, 2009). Indicator residual variances (σ_{e1}^2 through σ_{e11}^2) are allowed to covary across time because repeat assessments likely influence the observed variables. The latent true scores (y_{ti}) follow an autoregressive model, such that the latent true score at time *t* is a sum of the latent true score at the previous time point plus the amount of change that has occurred between time *t* – 1 and time *t*. This is written as

$$y_{ti} = y_{t-1i} + \Delta y_{ti}$$

where y_{t-1i} is the latent true score at time *t* – 1 for individual *i* and Δy_{ti} is the latent change score from time *t* – 1 to time *t*. These latent change scores represent the within-person rate of change between two consecutive time points and are included at each occasion after time 1 (McArdle, 2009). Before establishing the full latent change equation, it is important to first outline the equation for the latent true scores, which is

$$y_{ti} = y_{1i} + \sum_{r=2}^{r=t} (\Delta y_{ri})$$

where y_{1i} is the true score at the first occasion (i.e., the intercept) and $\sum_{r=2}^{r=t}(\Delta y_{ri})$ is a sum of the latent change scores from the second to the *i*th measurement occasion. Inserting this back into the first equation ($Y_{ti} = y_{ti} + e_{ti}$), the observed score at each time point comprises the initial true score, an accumulation of latent change scores, and noise (Grimm et al., 2016).

As indicated in Figure 3, autoregressive parameters are constrained to a value of 1, which reflects the assumption that the lag (i.e., the amount of time between consecutive latent true scores) is constant, even if the consecutive observed scores are not (Hamagami & McArdle 2001, 2007). If there is irregular lag between observed scores, one can include non-informative latent variables to serve as placeholders for the absent assessment points so that the latent true scores are equally spaced in time. No parameters are independently estimated for these variables (Barker et al., 2013). In the case of this model, because parents were not interviewed during wave 5 of data collection, the model includes non-informative latent variables as placeholders for most parents' self-reported math and sports values during grades 7 and 10.

As noted previously, the amount of change between time $t - 1$ and time t is a composite of systematic constant change (g_i) from the linear slope and a systematic proportional change (β) over time. This change equation for this model is

$$\Delta y_{ti} = g_i + \beta \cdot y_{t-1i}$$

As illustrated in Figure 3, constant change has a fixed weight of 1 across measurements and is composed of a mean (μ_g), a variance (σ_g^2), and a covariance with the initial true score (y_{1i}). The proportional change parameters (β) are fixed to be invariant across assessments both because they are assumed to be modeling a consistent underlying developmental process and to ease model estimation and interpretation. While the constant change parameter, or slope, reflects mean-level change over time, the proportional change parameter reflects change that is dependent on the level of the variable at the immediately preceding time point.

Combining the equation for the latent true scores ($y_{ti} = y_{1i} + \sum_{r=2}^{r=t}(\Delta y_{ri})$) and the change equation for the dual change model yields the following series of equations for the first three latent true scores:

$$y_{1i} = y_{1i}$$

$$y_{2i} = [y_{1i}] + g_i + \beta \cdot y_{t-1i}$$

$$y_{3i} = [y_{1i} + g_i + \beta \cdot y_{t-1i}] + g_i + \beta(y_{t-1i} + g_{1i} + \beta \cdot y_{t-1i})$$

Although complex, this series of equations illustrates that the latent true scores are determined by three parameters: The prior latent true score (contained within the brackets), the constant change component (g_i), and the proportional change parameter multiplied by the prior latent true score. Depending on the sign and magnitude of these three parameters, the variable's nonlinear growth trajectory follows an increasing or decreasing, accelerating or decelerating exponential form (McArdle & Grimm, 2010).

Working from the univariate dual change model just described, I can now discuss the specific change equations that were used to address Research Question 1—how do parents' self-reported math and sports values predict subsequent change in children's own values from first to 11th grade—and Research Question 2—are there child-driven reciprocal effects predicting subsequent change in parents' math and sports values. The following univariate equations describe change for mothers' self-reported values (Δm_{ti}), fathers' self-reported values (Δf_{ti}), and children's self-reported values (Δc_{ti}):

$$\Delta m_{ti} = g_i + \beta_m \cdot m_{t-1i}$$

$$\Delta f_{ti} = k_i + \beta_f \cdot f_{t-1i}$$

$$\Delta c_{ti} = d_i + \beta_c \cdot c_{t-1i}$$

The most notable difference after transitioning to the full multivariate LCS model shown in Figure 4 are the inclusion of dynamic effects to these change equations, which are the primary outcome of interest for Research Questions 1 and 2.

The prior equations are expanded to include coupling effects, such that

$$\Delta m_{ti} = g_i + \beta_m \cdot m_{t-1i} + \gamma_{tcm} \cdot c_{t-1i}$$

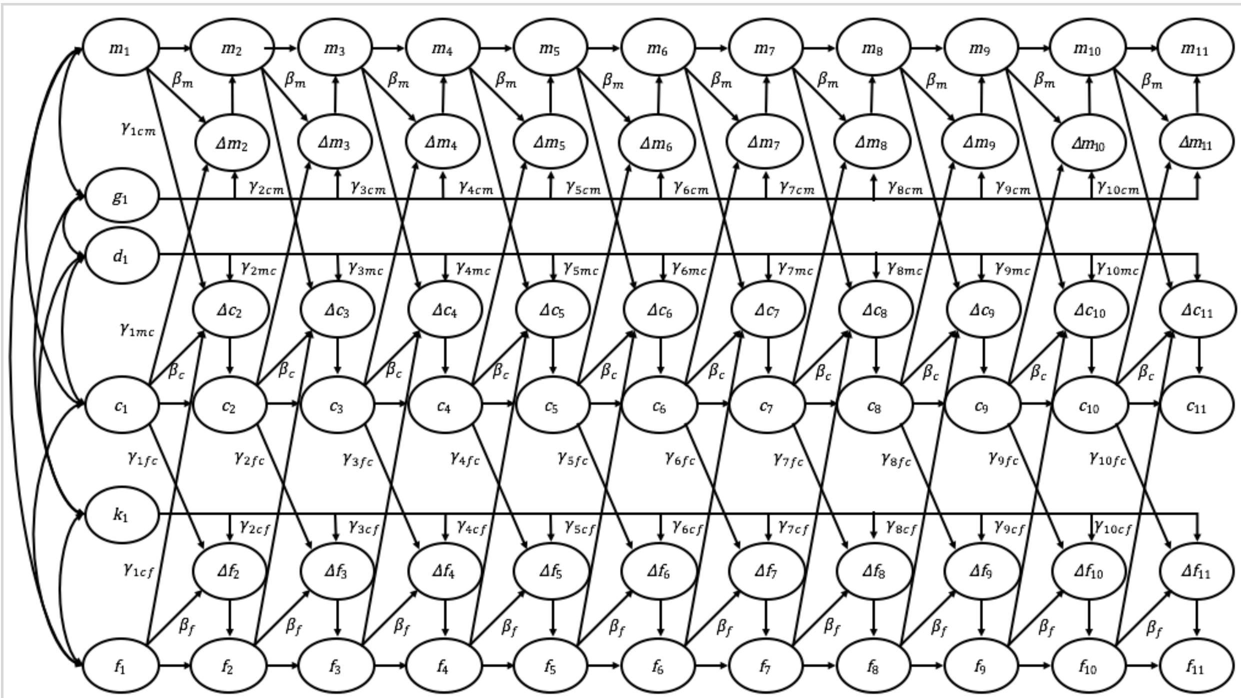
$$\Delta f_{ti} = k_i + \beta_f \cdot f_{t-1i} + \gamma_{tcf} \cdot c_{t-1i}$$

$$\Delta c_{ti} = d_i + \beta_c \cdot c_{t-1i} + \gamma_{tfc} \cdot f_{t-1i} + \gamma_{tmc} \cdot m_{t-1i}$$

where the γs are the coupling parameters that describe how the prior true score—in the case of γ_{tfc}, for example—for fathers (*f*) is related to subsequent true changes in children's (*c*) scores at time *t*. Because the model covers a decade of children's development, as noted in Chapter 2, the relations between mothers' and fathers' values and children's values are not assumed to stay

Figure 4

Multivariate Change Model of Children's, Mothers', Fathers' Values from First Through 11th Grade with Coupling



stable over that time. Thus, comparisons of fit between models that freely estimate coupling parameters at each time point versus models that constrain coupling parameters to be equal across time are conducted to confirm the most appropriate estimation of effects given the data.

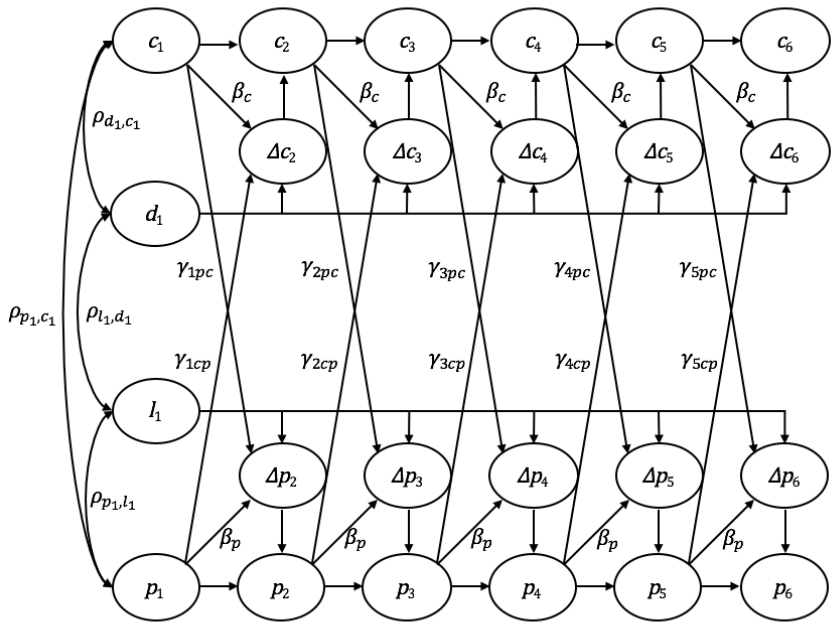
As seen in Figure 4, the labeling of path coefficients follow the previously discussed equations, and all unlabeled paths are fixed at 1 unless otherwise noted. There are three inputs for the latent change scores (e.g., Δm_2) in this model: (a) the constant change component, g_1, with a weight of 1; (b) the prior latent true score for mothers (e.g., m_1) with a weight of β_m; and (c) the prior latent true score for children (e.g., c_1) with a weight of γ_{1cm}. Because of the level of detail in Figure 4, not all parameters in the model are featured. The latent true scores have one or multiple measured indicators and factor loadings that are invariant across assessments. Indicator residual variances (σ^2_{em1} through σ^2_{em11}, σ^2_{ef1} through σ^2_{ef11}, σ^2_{ec1} through σ^2_{ec11}) are allowed to covary across assessments. These residual variances are also allowed to covary between mothers' and fathers' indicators at each measurement to acknowledge evidence that mothers' and fathers' often share the same beliefs and values (Fredricks & Eccles, 2005; Gladstone et al., 2018). The initial true scores (m_1, f_1, c_1) have means (μ_{m1}, μ_{f1}, μ_{c1}) and variances (σ^2_{m1}, σ^2_{f1}, σ^2_{c1}); the constant change components (g, k, d) also have means (μ_g, μ_k, μ_d) and variances (σ^2_g, σ^2_k, σ^2_d). Illustrated, but not labeled, in the figure are covariances among the initial true scores ($\rho_{m1,c1}$, $\rho_{m1,f1}$, $\rho_{c1,f1}$), among the constant change components ($\rho_{g,d}$, $\rho_{g,k}$, $\rho_{k,d}$), and between the two parameters for each set of variables ($\rho_{g,m1}$, $\rho_{k,d1}$, $\rho_{d,c1}$).

Given Eccles (Parsons) et al.'s (1983) and Eccles' (1993) theoretical models, the statistical models for the present study reflects the assumption that parents' and children's values reciprocally predict change in each other's values over time. To determine the necessity of child-driven coupling parameters (γ_{tfc} , γ_{tmc}), likelihood ratio tests are conducted comparing models when the coupling parameters are (separately and jointly) estimated versus fixed to 0 (Grimm et al., 2016). If γ_{tfc} and γ_{tmc} are necessary, then these parameters are considered leading indicators of the changes in their parents' task values. I use the term *leading indicator* to denote that, statistically, these child-driven effects are not causal but informative regarding the nature or sequence of subsequent changes in their parents' values (Grimm et al., 2016).

The model to address Research Question 3 (see Figure 5) reflects all of the previously discussed qualities of the model focusing on Research Questions 1 and 2. The primary difference is the simplification of the model to a bivariate LCS model, with different parameter labels reflecting those associated with children's perceptions of their parents' valuing of math and sports.

Figure 5

Bivariate Change Model of Children's Values and Children's Perceptions of Their Parents' Values with Coupling



Because I explored the two domains of math and sports, two separate models for each domain were used to address all of my research questions. Further, Research Questions 1.3, 2.2, and 3.3 all ask whether or not the relations in these models differ by child gender. Multi-group SEM analyses allow for making inferences about population differences in relations among both measured and latent variables. This process involves constraining all parameters of interest to be invariant across child gender groups and conducting a chi-squared difference test to expose the effects that are statistically different between male and female children.

There are a number of factors that determine how many participants and how many assessments are required to appropriately fit an SEM model to longitudinal data (Barker et al., 2014). These considerations also make it difficult to estimate how many participants are required to achieve adequate power for a given longitudinal analysis, particularly for those as complex as

Table 3

Number of participants by group for each grade

Grade	Children	Mothers	Fathers
1	235	194	122
2	494	342	217
3	451	261	180
4	433	274	174
5	305	205	134
6	288	184	112
7	167	–	–
8	300	101	63
9	123	100	68
10	227	–	–
11	165	154	96

the models I used. However, general statistical guidelines for longitudinal research bolster my confidence in successfully applying these models to the given dataset.

Although some researchers have recommended that 100–200 participants are needed to provide stable parameter estimates in longitudinal models, growth curve models have been successfully applied in samples significantly smaller than 100 (Curran et al., 2010). As indicated in Table 3, the sample of fathers is under 100 in eighth, ninth, and 11th grade. However, samples at all other time points for any group is above 100. Further, for longitudinal data, precision increases as the number of assessments increases and as the duration of the study increases (Collins, 2006). These models contain six to 11 repeated measurements over as many years and should help offset any loss in power resulting from smaller sample sizes.

Chapter 4: Results

Measurement Invariance

Prior to the construction of the four multi-group models used to address the present study's research questions, I developed measurement models for each group under investigation for the two domains of math and sports to test for measurement invariance across the 11 time points and across child gender. I carried out three consecutive tests of measurement invariance: Configural, metric (also known as weak factorial), and scalar (also known as strong factorial). In addition, to test for invariance across both time and child gender required several additional tests. Prior to testing for configural invariance across time and gender, I first tested whether the baseline measurement model was supported within each child gender group separately. If the baseline models were supported, then I would run a general model that aggregated the two child gender groups to identify any parameters that were not invariant across time. Finally, I would divide the analyses by gender and make alterations to the model if parameters were suggested by the modification indices to be not invariant by gender. I would then repeat the latter two steps for each addition of parameters and constraints.

In the process of measurement model formation, select post-hoc additions to the proposed models were made based on the modification indices produced as part of the Mplus output. The output indicated that the model fit would improve by estimating covariances between the two intrinsic items and between the two utility and attainment items in the models of children's values. Prior studies utilizing this data (i.e., Archambault, 2010; Jacobs et al., 2002) have combined these two sets of items to represent two facets of task value and I decided to follow this approach and incorporate these additions into the present study's models.

Before discussing the final measurement models and the processes I used to test them, I will first discuss the issues that I encountered which led me to make changes to the measurement models and, thus, the final models on which I report in the present study. During initial tests of measurement invariance, I attempted to demonstrate invariance across both time and child gender, which were two primary foci of the present dissertation study. However, in conducting these tests, two models (i.e., fathers' and mothers' math value) were unable to converge when fitting the least constrained version of the model that included either male or female children. Three additional models were unable to converge during latter steps of the invariance testing process (i.e., children's math and sports value) or during any step of the testing process (i.e., fathers' sports value).

Given that issues with non-convergence were encountered multiple times throughout this study, I will briefly discuss why they might occur. Convergence problems can be caused by a variety of factors. According to Muthén and Muthén (1998–2012) non-convergence is often related to a model being estimated that is not appropriate for the data. Further, certain models are more likely to experience convergence issues, such as more computationally complex models—a category to which latent change score models certainly belong—and models with random effects that have small variances. Finally, large negative variances or residual variances in the preliminary parameter estimates can prevent a model from converging. Regarding the non-convergence of the specific measurement models being discussed here, it is possible that there simply is not evidence of measurement invariance across *both* child gender and the multiple developmental periods contained within 11 years of measurement occasions. If this expectation were unrealistic, it would mean that the model being estimated was not appropriate for the data. Another potential explanation is that, given the complexity of these models, dividing samples by child gender could have exacerbated issues resulting from the number of missing data patterns in the dataset, resulting in non-convergence.

Because the majority of models testing invariance across gender and time experienced fit and/or convergence issues, additional tests of measurement invariance were conducted across time only. In effect, these alterations to the model eliminated investigations pertaining to Research Questions 1.3 and 2.2, which addressed whether predictive patterns differed by child gender or parent-child gender dyad. The time-invariant measurement models did converge and had acceptable omnibus fit (i.e., CFI > .95, RMSEA < .06, SRMR < .08; Hu & Bentler, 1999). Thus, I altered the analytical plan and models exploring these research questions to not include any comparisons of effects across child gender. The following discussion of results related to measurement invariance pertains to the testing of invariance across time only.

The extent to which each of the models exhibited measurement invariance was examined according to the four main steps described by Widaman and Reiss (1997): Configural, metric (also known as weak factorial), scalar (also known as strong factorial), and strict invariance (also known as residual or invariant uniqueness). As noted in Chapter 3, the present study did not expect residual invariance, so testing for strict invariance was omitted. I conducted nested model comparisons of the increasingly constrained measurement models using the difference in the model chi-square scores as a function of the difference in model degrees of freedom. I also included omnibus fit statistics in the identification of good measurement model fit. Table 4 shows the full fit statistics for each of the measurement models.

The first and least constrained step in the measurement invariance process is testing for configural invariance, or invariance of model form. This step is designed to test whether the basic organization of the constructs (i.e., four loadings on each latent factor) is supported across time and/or gender (Putnick & Bornstein, 2016). A configural invariance model was initially specified in which the factors at each occasion were estimated simultaneously. Factor variances and covariances between factors that shared data (as part of the same cohort) were estimated. Residuals between the same items across occasions also were allowed to covary. Attempts to include occasions for which parental value was measured only by one item—grades 1, 2, and 4 for the youngest, middle, and oldest cohorts, respectively—presented a missing data issue and failed to converge. Thus, those occasions were omitted from further invariance tests for parental constructs. In addition, an aggregated cohort model of children's sports values failed to converge for any step of the testing process. Therefore, the discussion below of invariance test results of children's sports value models refer to tests of the three separate cohort models. As shown in Table 4, omnibus fit statistics indicated good measurement model fit for all models that were over-identified (i.e., degrees of freedom were greater than zero). For those models that were just-identified (i.e., degrees of freedom equaled zero), measurement model fit was determined by SRMR; these models also showed good fit. Full configural invariance indicates that the basic organization of the constructs (i.e., four loadings on each latent factor) is supported across time.

Because configural invariance was supported, I then tested for metric invariance, or equivalence of the indicator factor loadings across occasions. Metric invariance means that each item contributes to the latent construct to a similar degree across time and/or gender (Putnick & Bornstein, 2016). All factor loadings were constrained to be equal across time. However, all indicator intercepts and variances were still permitted to vary across time. Factor means were estimated, and all other measurement model parameters were retained from the configural invariance model. As indicated in Table 4, for most groups, the metric invariance models did not fit significantly worse than the configural invariance models. The one exception is the sports

Table 4

Fit statistics of measurement models of invariance across time for measures of children's, mothers', and fathers' math and sports values

	Fit Statistics						
Math Models	χ^2	*df*	$\Delta\chi^2$	Δdf	CFI	RMSEA	SRMR
Children							
M1	489.34	297	–	–	0.96	0.03	0.06
M2	555.56	236	66.22	61	0.95	0.03	0.07
M3	739.14	355	183.58*	119	0.92	0.04	0.07
Mothers							
M1			Converged without fit statistics				
M2	3.86	5	–	–	Just identified		0.05
M3	16.38	10	12.52*	5	0.98	0.03	0.07
Fathers							
M1	2.29	1	–	–	1	0.06	0.03
M2	2.06	4	0.23	3	1		0.05
M3	13.53	8	11.47*	4	0.98	0.04	0.06
Sports Models							
Children							
Cohort 1							
M1	144.09	110	–	–	0.99	0.02	0.04
M2	155.26	122	11.17*	12	0.99	0.02	0.04
M3	227.28	134	72.02*	12	0.97	0.04	0.05
Cohort 2							
M1	180.15	110	–	–	0.98	0.03	0.05
M2	191.76	122	11.61	12	0.98	0.03	0.05
M3	249.02	134	57.26*	12	0.97	0.03	0.05
Cohort 3							
M1	208.54	110	–	–	0.98	0.04	0.05
M2	248.52	122	39.98*	12	0.97	0.04	0.07
M3	259.89	134	11.37	12	0.97	0.04	0.07
Mothers							
M1	1.87	0	–	–	Just identified		0.03
M2	9.22	5	7.35	5	0.99	0.03	0.04
M3	27.73	10	18.51*	5	0.97	0.06	0.05
Fathers							
M1	1.14	0	–	–	Just identified		0.06
M2	2.39	5	1.25	5	Just identified		0.06
M3	25.02	10	22.63*	5	0.97	0.06	0.08

Note. M1= model for configural invariance (no constraints); M2 = model for full metric invariance with all factor loadings constrained equal; M3 = model for scalar invariance with all intercepts constrained equal; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; CFI, comparative fit index; SRMR, standardized root mean residual.
*p < .05.

model for Cohort 3 ($\Delta\chi 2$ = 39.98, df = 12, p < .001). However, omnibus fit statistics still indicated good overall model fit (χ^2 = 248.52, CFI = .97, RMSEA = .04, SRMR = .07). In addition, indicator 1—which asked about the utility of the domain—for children's math value at grade 1 had a very low loading and the modification indices suggested as a source of misfit and should be freed. This source of invariance is consistent with the difficulty that Wigfield and colleagues (1997) discovered in their initial testing of the construct's reliability in children across time. The fact that full metric invariance held for all other models indicates that the indicators were related to the latent factor equivalently across time. In other words, the same latent factor was being measured at each occasion.

Because full or partial metric invariance was supported in all tested models, I then tested for scalar invariance, or equality of the indicator intercepts across occasions. Scalar invariance means that mean differences in the latent construct capture all mean differences in the shared variance of the items (Putnick & Bornstein, 2016). Indicator 1 for each occasion was fixed to 0 for each group so that the factor adopted the mean information associated with that variable. Factor loadings and remaining indicator intercepts were constrained to be equal across time (except for children's indicator 1 at grade 1 for math). Residual variances were allowed to differ across time. Factor covariances and indicator residual covariances were estimated as described previously. As shown in Table 4, the scalar invariance models for all groups in both domains fit significantly worse than the metric invariance models. Although this implies that at least one indicator intercept differs across measurements, measures of omnibus fit still indicate that these models are good fit for the data. Thus, one can still argue that mean differences in the latent construct capture all mean differences in the shared variance of the indicators (Putnick & Bornstein, 2016). The process of establishing scalar measurement invariance allows the present study to substantiate a number of comparisons across time. One can compare factor variances, covariances, and means while assuming that their differences are not attributable to age-based differences in the properties of the scales themselves.

Univariate Latent Change Score Models

To determine the most appropriate change model for each construct in each of the two domains of interest, three univariate models were fit to the data in increasing order of complexity. The models included the (a) basic change score model, where yearly changes are freely estimated from time to time; (b) proportional change model, where yearly changes are proportional to the level at the previous year; and (c) dual change model, where yearly changes have a constant influence *and* are proportional to the level at the previous year. Although these models are preliminary to testing my research questions, the univariate models illustrate how the math and sports values of each group change across time. Thus, the parameters from these models are instrumental for later interpretation of how one group's value shapes the value of another group.

As was discussed previously, smaller sample sizes and missing data patterns led to several adjustments that were made to the present study's models at each stage of their formation. Although the proposed models included two non-informative latent variables as placeholders for most parents' self-reported math and sports values during grades 7 and 10, there were convergence issues with these variables in place. This problem was remedied by removing the placeholder variables and using Wright's (1918, 1934) rules of path tracing to adjust the equation for the proportional parameters (i.e., β, when included) to $\beta\ (2 + \beta)$, depicting the change that occurs over a two-year span from grade 6 to grade 8 and from grade 9 to grade 11. There were a few additional overlapping parameters included in all models. First, covariances between the first factors in the model were included to reflect that each group's initial levels may be related. Second, I included covariances between the first factors and first change scores, which indicates that individuals' values change is related to their initial levels of value. Third, for models in which there is no overlying growth trajectory (i.e., proportional change, basic change) I included covariances between consecutive change scores to reflect that previous change is likely related to subsequent change.

Table 5 summarizes the fit information for the univariate latent change score models. Fit statistics to evaluation global fit, which compare the model prediction and observed data were included. Further, to conduct nested model comparisons of increasingly complex models of change, I computed chi-square difference tests to determine if modeling additional change processes were warranted and included these parameters as well. Given extensive research on developmental influences on change in children's task values (see Wigfield et al., 2006, 2009), I expected that the nature of change in task value for each group would involve both constant and proportional change. However, the chi-square test of fit and the other indices of model fit indicated that more parsimonious models of change fit best.

The model fit comparisons showed that the basic change model best captured longitudinal changes in children's math value (χ^2 (371) = 761.18, CFI = 0.92, RMSEA = .03), mothers' math value (χ^2 (41) = 104.97, CFI = 0.89, RMSEA = .05), and fathers' math value (χ^2 (28) = 54.88, CFI = 0.95, RMSEA = .04). Thus, yearly changes in children's, mothers', and fathers' math values were neither dependent upon previous level of value nor had a constant trajectory of change. Likewise, the basic change models also best captured longitudinal changes in children's sports values (χ^2 (371) = 648.95, CFI = 0.97, RMSEA = .03) and mothers' sports value (χ^2 (27) = 57.54, CFI = 0.97, RMSEA = .03). By contrast, a proportional change model

Table 5

Fit statistics for univariate latent change score models fit to measures of children's, mothers', and fathers' math and sports values

	Fit Statistics						
Model	χ^2	*df*	$\Delta\chi^2$	Δdf	CFI	RMSEA	SRMR
Children's math value							
1. Basic change †	761.18	371	–	–	0.92	0.03	0.13
2. Proportional change	792.30	380	31.12*	9	0.91	0.04	0.13
3. Dual change	968.77	398	176.47*	18	0.88	0.04	0.15
Mother's math value							
1. Basic change †	104.97	41	–	–	0.89	0.05	0.23
2. Proportional change	289.11	58	184.14*	17	0.56	0.07	0.26
3. Dual change	248.31	48	40.80*	10	0.62	0.08	0.37
Father's math value							
1. Basic change †	54.88	28	–	–	0.95	0.04	0.22
2. Proportional change	88.50	36	33.62*	8	0.90	0.05	0.23
3. Dual change	104.03	49	15.53	13	0.90	0.05	0.23
Children's sports value							
1. Basic change †	648.95	371			0.97	0.03	0.17
2. Proportional change	696.36	380	47.41*	9	0.96	0.03	0.17
3. Dual change	988.01	397	291.65*	17	0.93	0.04	0.19
Mother's sports value							
1. Basic change †	57.54	27	–	–	0.97	0.03	0.22
2. Proportional change	71.43	34	13.89*	7	0.97	0.04	0.23
3. Dual change	147.34	46	75.91*	12*	0.91	0.05	0.25
Father's sports value							
1. Basic change	64.57	26	–	–	0.96	0.05	0.24
2. Proportional change †	79.71	34	15.14	8	0.95	0.05	0.25
3. Dual change	123.76	45	44.05*	11	0.91	0.06	0.24

Note. χ^2, maximum likelihood chi-square; CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean residual.
† Denotes selected model.
**p* < .05.

best captured longitudinal changes in fathers' sports value (χ^2 (34) = 79.71, CFI = 0.95, RMSEA = .05). Thus, yearly changes in fathers' sports values were dependent on previous levels of their sports value.

The parameter estimates for the model of children's math value (shown in Table 6) indicate that children reported an average math value of 5.26 during first grade. Estimates also show that there was significant variation in the level of math value at grade 1 (σ^2_{cmv1} = 1.04, $p <$ .001) and in the yearly changes in math value, with the exception of change from first to second grade ($\sigma^2_{\Delta cmv12}$ = .55, $p > .05$) and from ninth to tenth grade ($\sigma^2_{\Delta cmv12}$ = .24, $p > .05$). However, most average yearly changes in children's math value were not significant, with the exception of change from fourth to fifth grade ($\mu_{\Delta cmv67}$ = – 0.24, $p < .05$) and from sixth to seventh grade ($\mu_{\Delta cmv67}$ = – 0.55, $p < .001$). Thus, although children primarily showed declining values from first grade to 11th grade, few yearly changes in their values were significantly different from zero.

Parameter estimates for the model of children's sports value (also shown in Table 6) indicate that children reported an average sports value of 6.35 during first grade. Estimates also show that there was significant variation in the level of sports value at grade 1 (σ^2_{csv1} = 1.04, $p <$ .001), and in the yearly changes in sports value, with the exception of change from sixth to seventh grade ($\sigma^2_{\Delta csv12}$ = .22, $p > .05$) and from ninth to tenth grade ($\sigma^2_{\Delta csv910}$ = .06, $p > .05$). Average yearly changes in sports value showed primarily significant negative change from third grade to 11th grade, with the exception of two nonsignificant changes from fourth to fifth grade ($\mu_{\Delta csv45}$ = – 0.001, $p > .05$) and ninth to tenth grade ($\mu_{\Delta csv910}$ = 0.01, $p > .05$) and a significant positive change from sixth to seventh grade ($\mu_{\Delta csv67}$ = 0.44, $p < .05$). These findings show that

Table 6

Parameter estimates for the chosen univariate latent change score model fit to children's math and sports values

		Math	Sports
Means (μ)			
μ_{cmv1}	μ_{csv1}	5.26*	6.35*
$\mu_{\Delta cmv12}$	$\mu_{\Delta csv12}$	– 0.06	0.01
$\mu_{\Delta cmv23}$	$\mu_{\Delta csv23}$	0.02	– 0.003
$\mu_{\Delta cmv34}$	$\mu_{\Delta csv34}$	– 0.11	– 0.14*
$\mu_{\Delta cmv45}$	$\mu_{\Delta csv45}$	– 0.24*	– 0.001
$\mu_{\Delta cmv56}$	$\mu_{\Delta csv56}$	– 0.17	– 0.34*
$\mu_{\Delta cmv67}$	$\mu_{\Delta csv67}$	– 0.55*	0.44*
$\mu_{\Delta cmv78}$	$\mu_{\Delta csv78}$	– 0.19	– 0.40*
$\mu_{\Delta cmv89}$	$\mu_{\Delta csv89}$	– 0.04	– 0.38*
$\mu_{\Delta cmv910}$	$\mu_{\Delta csv910}$	– 0.13	0.10
$\mu_{\Delta cmv1011}$	$\mu_{\Delta csv1011}$	– 0.08	– 0.27*
Random effects (variances and covariances)			
σ^2_{cmv1}	σ^2_{csv1}	1.32*	1.04*
$\sigma_{\Delta cmv12}$	$\sigma_{\Delta csv12}$	0.55	1.26*
$\sigma_{\Delta cmv23}$	$\sigma_{\Delta csv23}$	0.87*	0.91*
$\sigma_{\Delta cmv34}$	$\sigma_{\Delta csv34}$	0.96*	0.80*
$\sigma_{\Delta cmv45}$	$\sigma_{\Delta csv45}$	1.34*	0.43*
$\sigma_{\Delta cmv56}$	$\sigma_{\Delta csv56}$	1.07*	0.93*
$\sigma_{\Delta cmv67}$	$\sigma_{\Delta csv67}$	1.11*	0.22
$\sigma_{\Delta cmv78}$	$\sigma_{\Delta csv78}$	1.28*	0.69*
$\sigma_{\Delta cmv89}$	$\sigma_{\Delta csv89}$	1.15*	0.77*
$\sigma_{\Delta cmv910}$	$\sigma_{\Delta csv910}$	0.24	0.06
$\sigma_{\Delta cmv1011}$	$\sigma_{\Delta csv1011}$	0.78*	0.54*
$cmv_1 \leftrightarrow \Delta cmv_{12}$	$csv_1 \leftrightarrow \Delta csv_{12}$	– 0.29	– 0.69*

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; cmv_1, latent intercept for child math value; csv_1, latent intercept for child sports value; $\Delta cmv[t]$ latent change factor for child math value at time *t*; $\Delta csv[t]$ latent change factor for child sports value at time *t*.
*$p < .05$.

children's math and sports values follow a fairly consistent downward trajectory from first grade to 11th grade, although changes in children' math value are largely non-significant. For clarification, these results should be understood to complement rather than contradict the findings of Jacobs et al. (2002) which portray these constructs to have significant and negative growth trajectories from first grade to 12th grade. Jacobs found that the *overall* rate of decline for children's math and sports values was significant. By contrast, because latent change score models can test incremental change, the present findings show that year-by-year change is small and not significantly different from zero in many instances.

The parameter estimates for the model of mothers' math value (shown in Table 7) indicate that mothers reported an average math value for their children of 6.25 while their children were in first grade. Estimates also show that there was significant variation in the level of math value at grade 1 (σ^2_{mmv1} = 0.56, $p < .001$), but variation in yearly changes were significant only from first to second grade and throughout middle school. Average yearly changes in mothers' math value were significant throughout elementary school, showing primarily increases in math value with the exception of a significant decrease in value from third to fourth grade ($\mu_{\Delta mmv34}$ = – 0.22, $p < .001$). However, mothers did not show significant average yearly changes in math value during middle and high school with the exception of a significant decrease in math value from ninth to 11th grade ($\mu_{\Delta mmv34}$ = – 0.17, $p < .01$).

The parameter estimates for the model of fathers' math value (also shown in Table 7) indicate that fathers reported an average math value for their children of 6.18 while their children were in first grade. Estimates also show that there was significant variation in the level of math value at grade 1 (σ^2_{fmv1} = 0.59, $p < .001$) and yearly changes from first through fourth grade, but

Table 7

Parameter estimates for the chosen univariate latent change score models fit to mothers' and fathers' math values for their children

		Mothers	Fathers
Means (μ)			
μ_{mmv1}	μ_{fmv1}	6.25*	6.18*
$\mu_{\Delta mmv12}$	$\mu_{\Delta fmv12}$	0.35*	0.09
$\mu_{\Delta mmv23}$	$\mu_{\Delta fmv23}$	0.21*	0.25*
$\mu_{\Delta mmv34}$	$\mu_{\Delta fmv34}$	– 0.22*	– 0.05
$\mu_{\Delta mmv45}$	$\mu_{\Delta fmv45}$	0.14*	0.06
$\mu_{\Delta mmv56}$	$\mu_{\Delta fmv56}$	0.04	0.05
$\mu_{\Delta mmv68}$	$\mu_{\Delta fmv68}$	0.09	– 0.07
$\mu_{\Delta mmv89}$	$\mu_{\Delta fmv89}$	– 0.05	– 0.02
$\mu_{\Delta mmv911}$	$\mu_{\Delta fmv911}$	– 0.17*	– 0.01
Random effects (variances and covariances)			
σ^2_{mmv1}	σ^2_{fmv1}	0.56*	0.59*
$\sigma_{\Delta mmv12}$	$\sigma_{\Delta fmv12}$	0.40*	0.46*
$\sigma_{\Delta mmv23}$	$\sigma_{\Delta fmv23}$	0.001	0.21*
$\sigma_{\Delta mmv34}$	$\sigma_{\Delta fmv34}$	0.04	0.20*
$\sigma_{\Delta mmv45}$	$\sigma_{\Delta fmv45}$	0.05*	0.16
$\sigma_{\Delta mmv56}$	$\sigma_{\Delta fmv56}$	0.05*	0.10
$\sigma_{\Delta mmv68}$	$\sigma_{\Delta fmv68}$	0.12*	0.02
$\sigma_{\Delta mmv89}$	$\sigma_{\Delta fmv89}$	0.02	0.26*
$\sigma_{\Delta mmv911}$	$\sigma_{\Delta fmv911}$	0.10	0.14
$mmv_1 \leftrightarrow \Delta mmv_{12}$	$fmv_1 \leftrightarrow \Delta fmv_{12}$	– 0.41*	– 0.26*

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; mmv_1, latent intercept for mother math value; fmv_1, latent intercept for father math value; Δmmv[*t*] latent change factor for mother math value at time *t*; Δfmv[*t*] latent change factor for father math value at time *t*.
**p* < .05.

Table 8

Parameter estimates for the chosen univariate latent change score models fit to mothers' and fathers' sports values for their children

		Mothers	Fathers
Means (μ)			
μ_{msv1}	μ_{fsv1}	4.20*	4.23*
$\mu_{\Delta msv12}$		0.11	
$\mu_{\Delta msv23}$		0.05	
$\mu_{\Delta msv34}$		0.03	
$\mu_{\Delta msv45}$		0.01	
$\mu_{\Delta msv56}$		– 0.04	
$\mu_{\Delta msv68}$		0.06	
$\mu_{\Delta msv89}$		– 0.15	
$\mu_{\Delta msv911}$		– 0.30	
Dynamic Parameters			
	fsv[*t*–1] → Δfsv[*t*] (β_F)		– 0.003
	fsv[*t*–1] → Δfsv[*t*] (β_F*)		– 0.01
Random effects (variances and covariances)			
σ^2_{msv1}	σ^2_{fsv1}	0.42	1.39*
$\sigma_{\Delta msv12}$	$\sigma_{\Delta fsv12}$	0.31	0.09
$\sigma_{\Delta msv23}$	$\sigma_{\Delta fsv23}$	0.24	0.55*
$\sigma_{\Delta msv34}$	$\sigma_{\Delta fsv34}$	0.21	0.40*
$\sigma_{\Delta msv45}$	$\sigma_{\Delta fsv45}$	0.12	0.17
$\sigma_{\Delta msv56}$	$\sigma_{\Delta fsv56}$	0.28*	0.33*
$\sigma_{\Delta msv68}$	$\sigma_{\Delta fsv68}$	0.24	0.57
$\sigma_{\Delta msv89}$	$\sigma_{\Delta fsv89}$	0.25	0.28
$\sigma_{\Delta msv911}$	$\sigma_{\Delta fsv911}$	0.64	0.17
$msv_1 \leftrightarrow \Delta msv_{12}$	$fsv_1 \leftrightarrow \Delta fsv_{12}$	0.45*	– 0.16

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; msv_1, latent intercept for mother sports value; fsv_1, latent intercept for father sports value; Δmsv[*t*] latent change factor for mother sports value at time *t*; Δfsv[*t*] latent change factor for father sports value at time *t*; β_F, proportional change parameter for one year of change in fathers' sports value; β_F*, proportional change parameter for two years of change in fathers' sports value.
*$p < .05$.

there was little significant variation in yearly changes after that, with the exception of change from eighth to ninth grade ($\sigma^2_{\Delta fmv89}$ = 0.26, p < .05). By contrast, average yearly changes in fathers' math value only were significant from second to third grade ($\mu_{\Delta fmv23}$ = 0.25, p < .001). These findings suggest that, on average, fathers' math value for their children did not significantly change from first grade through 11th grade.

The parameter estimates for the model of mothers' sports value (shown in Table 8) indicate that mothers reported an average sports value for their children of 4.20 while children were in first grade. Estimates also show that variation in the level of sports value was neither significant at grade 1 (σ^2_{fmv1} = 0.42, p > .05) nor in yearly changes in their sports value, with the exception of change from fifth to sixth grade ($\sigma^2_{\Delta fmv56}$ = 0.28, p < .001). Thus, mothers reported similar initial levels sports value and yearly change in sports value. Further, average yearly changes in mothers' sports value were not significant at any time point. This finding suggests that, on average, mothers' sports value for their children did not significantly change from first grade through 11th grade.

The parameter estimates for the model of fathers' sports value (also shown in Table 8) indicate that fathers reported an average sports value for their children of 4.23 while their children were in first grade. Estimates also show that there was significant variation in the level of fathers' sports value at grade 1 (σ^2_{fsv1} = 1.39, p < .001), but variation in yearly changes in sports value only were significant from second to fourth grade and fifth to sixth grade. Further, the proportional change parameter for fathers' sports value was not significant (β_f = – 0.003, p > .05), meaning that yearly changes were not significantly affected by previous scores.

Although the final univariate models fit to children's, mothers', and fathers' math and sports values exhibited good omnibus fit regarding RMSEA (as seen in Table 5), the CFI—which is a ratio between the null and proposed model—for models of change in mothers' and children's math value were lower than the threshold for what is considered acceptable fit (Hu & Bentler, 1999). Low CFI may indicate high correlations between variables, which may be a result of relatively stable and overly high values—potentially indicating a ceiling effect—in the math values of these groups. Another issue that involved the omnibus fit of every model was a curiously high SRMR (0.13–0.25), which is the standardized difference between observed correlations and proposed correlations. Because this occurred for all models in the study and contradicts other omnibus measures (e.g., RMSEA) that indicate good data fit, it is difficult to postulate why this fit index is high. It is possible that because these standards of fit were established prior to the development of latent change score models (Hu & Bentler, 1999)—which are fairly new and are still being established as popular methods of analyzing data (e.g., McArdle & Hamagami, 2001)—conventionally utilized standards of model fit are not suitable for this type of model.

Bivariate Latent Change Score Models

As described in my data analysis plan in Chapter 3, I fit a series of bivariate latent change score models to address Research Questions 1.1 and 2.1. These questions concerned whether there are reciprocal effects between parents' and children's values and if these effects differ in magnitude from year to year throughout the study period. Because of the complexity of the analyses and results I highlight the main findings for each research question in bold in the text.

The series of bivariate latent change score models tested the fit of four possible leading indicator arrangements: (a) coupling parameters (i.e., regression of change in value one another group on the previous value of one group) fixed to 0 (i.e., no coupling), (b) parents' value as a leading indicator of children's value (i.e., *mmv* $\rightarrow$ Δ*cmv*), (c) children's value as a leading indicator of change in parents' value (i.e., *cmv* $\rightarrow$ Δ*mmv*), and (d) coupling parameters simultaneously estimated (i.e., full coupling). The bivariate models retained all qualities of the univariate models, but also estimated a covariance between the first factors of the two groups to reflect that parents' and children's initial levels of value were likely related. Traditional latent change score models constrain all coupling parameters to be equal across time points. However, I proposed that coupling effects were likely to differ across time due to the study taking place across several developmental periods. Thus, I fit two series of bivariate models, one with coupling parameters constrained to be equal across time and another where they were freely estimated across time. Table 9 contains fit information for both series of tests conducted on the four bivariate latent change score models. Nested model comparisons were conducted using chi-square difference tests were used to determine the four best-fitting models. Convergence issues were encountered multiple times throughout the testing process with regard to the sports models; these models were eliminated as options.

For the bivariate model of mothers' and children's math value, fit tests indicated that the model in which children's math value was a freely estimated leading indicator of subsequent changes in mothers' math value (*cmv* $\rightarrow$ Δ*mmv*) fit significantly better than the no coupling model ($\Delta\chi^2(8) = 16.14$, $p < .05$). Tests also indicated that the freely estimated full coupling model did not fit significantly better than the *cmv* $\rightarrow$ Δ*mmv* model. Being the more parsimonious model, the latter model was chosen as the best representation of the dynamic association—how one construct impacts the motion of other construct and vice versa—between mothers' and children's math value. Thus, contrary to my hypothesis for Research Question 1.1 that both

Table 9

Fit Statistics for bivariate latent change score models jointly fit to data on children's, mothers', and fathers' values in (A) math and (B) sports

(A)		Constrained Coupling			Freely Estimated Coupling		
Fit Statistics	No Coupling	$mmv_{[t-1]} \rightarrow \Delta cmv_{[t]}$	$cmv_{[t-1]} \rightarrow \Delta mmv_{[t]}$	Full Coupling	$mmv_{[t-1]} \rightarrow \Delta cmv_{[t]}$	$cmv_{[t-1]} \rightarrow \Delta mmv_{[t]}$ †	Full Coupling
χ2	1473.06	1471.05	1472.77	1470.49	1463.41	1456.92	1446.76
df	806	805	805	804	798	798	790
Δχ2	–	2.01	0.29	2.57	9.65	16.14*	10.16
Δ*df*	–	1	1	2	8	8	8
	No Coupling	$fmv_{[t-1]} \rightarrow \Delta cmv_{[t]}$	$cmv_{[t-1]} \rightarrow \Delta fmv_{[t]}$	Full Coupling	$fmv_{[t-1]} \rightarrow \Delta cmv_{[t]}$	$cmv_{[t-1]} \rightarrow \Delta fmv_{[t]}$	Full Coupling†
χ2	1443.39	1397.96	1396.15	1443.20	1429.46	1434.37	1365.33
df	802	782	780	800	794	794	764
Δχ2	–	45.43*	47.24*	– 47.05*	13.93	9.02	30.82
Δ*df*	–	20	22	20	8	8	16
(B)		Constrained Coupling			Freely Estimated Coupling		
Fit Statistics	No Coupling	$msv_{[t-1]} \rightarrow \Delta csv_{[t]}$	$csv_{[t-1]} \rightarrow \Delta msv_{[t]}$	Full Coupling†	$msv_{[t-1]} \rightarrow \Delta csv_{[t]}$	$csv_{[t-1]} \rightarrow \Delta msv_{[t]}$	Full Coupling
χ2	1237.83	1211.17	NC	1200.90	NC	NC	1179.17
df	778	777	NC	776	NC	NC	762
Δχ2	–	26.66*	–	10.27*	–	–	21.73
Δ*df*	–	1	–	1	–	–	14
	No Coupling	$fsv_{[t-1]} \rightarrow \Delta csv_{[t]}$	$csv_{[t-1]} \rightarrow \Delta fsv_{[t]}$	Full Coupling	$fsv_{[t-1]} \rightarrow \Delta csv_{[t]}$	$csv_{[t-1]} \rightarrow \Delta fsv_{[t]}$	Full Coupling†
χ2	NC	NC	NC	NC	NC	1317.44	1288.43
df	NC	NC	NC	NC	NC	779	771
Δχ2	–	–	–	–	–	–	29.01*
Δ*df*	–	–	–	–	–	–	8

Note. cmv, children's math value; mmv, mothers' math value; fmv, fathers' math value; csv, children's sports value; msv, mothers' sports value; fsv, fathers' sports value; χ^2, maximum likelihood chi-square; NC, no convergence.
† Denotes selected model.
**p* < .05.

mothers' and fathers' math value would predict change in children's math value, **mothers' self-reported math value was not found to be a significant predictor of subsequent changes in children's valuing of math.** However, confirming my hypothesis for Research Question 2.1 that children's math value would impact change in their parents' math values and that these effects would vary across developmental periods, **children's math value was found to be a significant predictor of subsequent changes in mothers' valuing of math for their children, of which the effects varied across the study period.**

For the bivariate model of fathers' and children's math value, fit tests indicated that the model in which children's math value was a constrained leading indicator of subsequent changes in fathers' math value (*cmv* → Δ*fmv*) fit significantly better than the no coupling model ($\Delta\chi^2(22)$ = 47.24, $p < .01$). When compared to the *cmv* → Δ*fmv* model, the constrained full coupling model fit significantly worse ($\Delta\chi^2(20) = 47.05$, $p < .001$). As a final test, the freely estimated full coupling model was compared to *cmv* → Δ*fmv* model. The full coupling model fit significantly better ($\Delta\chi^2(16) = 30.82$, $p < .05$), and was chosen as the best representation of the dynamic association between fathers' and children's math value. Thus, confirming my hypothesis for Research Question 1.1 that the fathers' math value would predict change in children's value, that these effects would differ from that of mothers' math value, and that these effects would vary across developmental periods, **fathers' math value for their children was found to be a significant predictor of subsequent changes in children's math value, of which the effects varied across the study period.** Likewise, again confirming my hypothesis for Research Question 2.1 that children's math value would impact change in both of their parents' math values and that these effects would vary across developmental periods, **children's math value**

was found to be a significant predictor of subsequent changes in fathers' math value for their children, of which the effects varied across the study period.

For the bivariate model of mothers' and children's sports value, fit tests indicated that the model in which mothers' sports value was a constrained leading indicator of subsequent changes in children's sports value ($msv \rightarrow \Delta csv$) fit significantly better than the no coupling model ($\Delta\chi^2(1) = 26.66$, $p < .001$). The constrained full coupling model fit better than the $msv \rightarrow \Delta csv$ model ($\Delta\chi^2(1) = 10.27$, $p < .01$). Because the freely estimated full coupling model did not fit significantly better than the constrained full coupling model ($\Delta\chi^2(14) = 21.73$, $p > .05$), the constrained full coupling model was selected as the best representation of the dynamic association between mothers' and children's sports value. Thus, confirming my hypothesis for Research Question 1.1 that the parents' sports values would predict change in children's sports value but contrary to my hypothesis that these effects would vary across developmental periods, **mothers' sports value for their children was found to be a significant predictor of subsequent changes in children's sports value, of which the effects did not vary across the study period.** Likewise, confirming my hypothesis for Research Question 2.1 that children's sports value would impact change in their parents' sports values but contrary to my hypothesis that these effects would vary across developmental periods, **children's sports value was found to be a significant predictor of subsequent changes in mothers' sports value for their children, of which the effects did not vary across the study period**.

For the bivariate model of fathers' and children's sports value, only two models converged with which to conduct a comparison. Of this comparison, the fit test indicated that the freely estimated full coupling model fit significantly better than the model in which children's sports value was a freely estimated leading indicator of subsequent changes in fathers' sports value (*csv* → Δ*fsv*; $\Delta\chi^2(8) = 29.01$, $p < .01$). Thus, the freely estimated full coupling model was chosen as the best representation of the dynamic association between fathers' and children's sports value. Thus, confirming my hypotheses for Research Question 1.1 that the fathers' sports value would predict change in children's value, that these effects would differ from that of mothers' sports value, and that these effects would vary across developmental periods, **fathers' sports value for their children was found to be a significant predictor of subsequent changes in children's sports value, of which the effects varied across the study period.** Likewise, confirming my hypothesis for Research Question 2.1 that children's sports value would impact change in their parents' sports values and that that these effects would vary across developmental periods, **children's sports value was found to be a significant predictor of subsequent changes in fathers' sports value for their children, of which the effects varied across the study period**.

Final Models Depicting Dynamic Relations Between Parents' and Children's Values

To investigate the dynamic relations between mothers', fathers', and children's values, I fit two multivariate latent change score models in the domains of math and sports. These models addressed Research Questions 1.1 and 2.1 in more detail, exploring *how* reciprocal effects between parents' and children's values differed from year to year throughout the study period. In addition, these models addressed Research Questions 1.2 and 2.2, regarding differences in how mothers' and fathers' values predicted change in children's values across time. The fit statistics and parameter estimates for the multivariate model for math value are contained in Table 10. The model retained most of the qualities discussed in the construction of the two bivariate math models. However, issues with non-convergence—likely due to the small variances of a number of parents' change scores—resulted in the removal of the covariances between mothers'

Table 10

Parameter estimates and fit statistics for the multivariate latent change score model fit to children's, mothers', and fathers' math values

			Child Value	Mother Value	Father Value
Means (μ)					
μ_{cmv1}	μ_{mmv1}	μ_{fmv1}	5.14*	6.26*	5.14*
Dynamic parameters			fmv → Δcmv	cmv → Δmmv	cmv → Δfmv
$fmv_1 \rightarrow \Delta cmv_{12}$ (γ_{C12F1})	$cmv_1 \rightarrow \Delta mmv_{12}$ (γ_{M12C1})	$cmv_1 \rightarrow \Delta fmv_{12}$ (γ_{F12C1})	0.40	– 0.16	0.04
$fmv_2 \rightarrow \Delta cmv_{23}$ (γ_{C23F2})	$cmv_2 \rightarrow \Delta mmv_{23}$ (γ_{M23C2})	$cmv_2 \rightarrow \Delta fmv_{23}$ (γ_{F23C2})	0.07	– 0.04	– 0.05
$fmv_3 \rightarrow \Delta cmv_{34}$ (γ_{C34F3})	$cmv_3 \rightarrow \Delta mmv_{34}$ (γ_{M34C3})	$cmv_3 \rightarrow \Delta fmv_{34}$ (γ_{F34C3})	– 0.09	0.03	0.03
$fmv_4 \rightarrow \Delta cmv_{45}$ (γ_{C45F4})	$cmv_4 \rightarrow \Delta mmv_{45}$ (γ_{M45C4})	$cmv_4 \rightarrow \Delta fmv_{45}$ (γ_{F45C4})	0.66*	0.01	0.06
$fmv_5 \rightarrow \Delta cmv_{56}$ (γ_{C56F5})	$cmv_5 \rightarrow \Delta mmv_{56}$ (γ_{M56C5})	$cmv_5 \rightarrow \Delta fmv_{56}$ (γ_{F56C5})	– 0.41	0.03	– 0.09*
$fmv_6 \rightarrow \Delta cmv_{67}$ (γ_{C67F6})	$cmv_6 \rightarrow \Delta mmv_{68}$ (γ_{M68C6})	$cmv_6 \rightarrow \Delta fmv_{68}$ (γ_{F68C6})	– 0.65*	– 0.13*	– 0.21*
$fmv_8 \rightarrow \Delta cmv_{89}$ (γ_{C89F8})	$cmv_8 \rightarrow \Delta mmv_{89}$ (γ_{M89C8})	$cmv_8 \rightarrow \Delta fmv_{89}$ (γ_{F89C8})	1.06*	0.04	0.25*
$fmv_9 \rightarrow \Delta cmv_{910}$ (γ_{C910F9})	$cmv_9 \rightarrow \Delta mmv_{911}$ (γ_{M911C9})	$cmv_9 \rightarrow \Delta fmv_{911}$ (γ_{F911C9})	– 0.67*	0.09*	0.09
Random effects (variances and covariances)					
σ^2_{cmv1}	σ^2_{msv1}	σ^2_{fsv1}	1.17*	0.50*	0.36*
$cmv_1 \leftrightarrow mmv_1$			0.16*		
$cmv_1 \leftrightarrow fmv_1$			– 0.01		
$fmv_1 \leftrightarrow mmv_1$			0.06*		
Fit statistics					
–2LL				–38856.88	
df				1316	
AIC				78423.76	
BIC				80109.57	

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a covariance; AIC, Akaike information criterion; BIC, Bayesian information criterion; cmv_1, latent intercept for child math value; mmv_1, latent intercept for mother math value; fmv_1, latent intercept for father math value; Δcmv[*t*] latent change factor for child math value at time *t*; Δmmv[*t*] latent change factor for mother math value at time *t*; Δfmv[*t*] latent change factor for father math value at time *t*.
**p* < .05.

consecutive change scores as well as between fathers' consecutive change scores. Residual covariances were added between mothers' and fathers' indicators that shared item wording (e.g., all first items) and data overlap. In addition, a covariance between the first factors of the two groups were included to reflect that mothers' and fathers' initial levels of math value were likely related.

Results indicate that initial levels of children's and mothers' math values were significantly related, as were initial levels of mothers' and fathers' math values. However, initial levels of fathers' math values were not related to those of their children. As discussed previously when fitting the bivariate models of math change, fit tests indicated that children's math value was a freely estimated leading indicator of subsequent changes in mothers' math value ($cmv \rightarrow \Delta mmv$). Fit tests also indicated that children's math value was a freely estimated leading indicator of subsequent changes in fathers' math value ($cmv \rightarrow \Delta fmv$) and fathers' math value as a freely estimated leading indicator of subsequent changes in children's math value ($fmv \rightarrow \Delta cmv$). The focus of the latent change score models are the change equations, so the change equations for the multivariate model of math value were

$$\Delta cmv_{ti} = 5.14 + cmv_{t-1} + \gamma_{\mathrm{fsv[t]\Delta csv}[t]} \cdot fmv_{t-1i}$$

$$\Delta mmv_{ti} = 6.26 + mmv_{t-1} + \gamma_{\mathrm{csv[t]\Delta msv}[t]} \cdot cmv_{t-1i}$$

$$\Delta dmv_{ti} = 6.19 + dmv_{t-1} + \gamma_{\mathrm{csv[t]\Delta fsv}[t]} \cdot cmv_{t-1i}$$

The following discussion of the results focuses exclusively on the coupling parameters (γ) as these parameters reflect the dynamic interplay between parents' and children's values. Significant coupling parameters are regarded as leading indicators for change in the other group. As previously discussed in Chapter 3, a leading indicator can be considered a developmental antecedent because it provides a prediction of the expected changes in the lagging variable.

Because all three sets of coupling parameters were freely estimated, interpreting how they impact change can be fairly complex. However, there are some patterns that facilitate interpretation. The model shows that **fathers' math value significantly and positively predicted yearly change in children's math value at two time points: Δcmv_{45} and Δcmv_{89}**. As indicated by the univariate model of children's math value, average changes in math value showed decreases during those times. Thus, **higher levels of fathers' math value for their children during fourth and eighth grade tended to slow the negative yearly change in children's math value from fourth to fifth grade and from eighth to ninth grade, respectively**. By contrast, the model shows that **fathers' math value for their children significantly and negatively predicted yearly change in children's math value at two time points: Δcmv_{67} and Δcmv_{910}**. Because average changes in children's math value also showed decreases during these times, **higher levels of fathers' math value for their children during sixth and ninth grade tended to lead to more negative yearly change in children's math value from sixth to seventh grade and from ninth to tenth grade.**

Likewise, the model shows that **children's math value significantly and negatively predicted yearly change in fathers' math value for their children at two time points: Δfmv_{56} and Δfmv_{68}, and significantly and positively predicts yearly changes in fathers' math value for their children at one time point: Δfmv_{89}**. As indicated by the univariate model of fathers' math value for their children, none of the average yearly changes in value during these time points were significant. Therefore, I can only make a general interpretation of how these effects shaped fathers' math value. Regarding the first two effects, **higher levels of children's math value during fifth and sixth grade tended to result in more negative yearly change in fathers' valuing of math for their children from fifth to eighth grade**. Regarding the last effect, **higher levels of children's math value during eighth grade tended to result in more positive yearly change in fathers' math value for their children from eighth to ninth grade.**

The coupling parameters from children's math value to changes in mothers' math value contained the fewest number of significant effects. The model shows that **children's math value significantly and negatively predicted change in mothers' math value for their children from sixth to eighth grade, and significantly and positively predicted change in mothers' math value for their children from ninth to 11th grade**. Because the univariate model of mothers' math value for their children showed that average yearly change during the first time period was not significant, I can only make a general interpretation of how this effect shaped mothers' math value. Regarding the first effect, **higher levels of children's math value during sixth grade tended to result in more negative yearly change in mothers' math value for their children from sixth to eighth grade**. Regarding the second time point, average changes in mothers' math value for their children showed decreases during this time. Thus, **higher levels of children's math value during ninth grade tended to slow the negative yearly change in mothers' math value for their children from ninth to eleventh grade**. To summarize my findings in the math domain, I found that fathers' math value both positively and negatively influenced change in children's math values from first grade to 11th grade, and children's values both positively and negatively influenced change in both mothers' and fathers' math values from first grade to 11th grade, consistent with my hypotheses. However, mothers' math value did not impact change in children's math value during the study period.

I intended to explore how mothers' and fathers' values uniquely impacted subsequent change in children's sports values through a multivariate model similar to that constructed for the math domain to address Research Questions 1.2 and 2.2. However, the multivariate model did

Table 11

Parameter estimates and fit statistics for the bivariate latent change score model fit to children's and mothers' sports values

		Child Value	Mother Value
Means (μ)			
μ_{csv1}	μ_{msv1}	6.35*	4.22*
Dynamic parameters			
msv[t–1] → Δcsv[t] (γ_{CM})	csv[t–1] → Δmsv[t] (γ_{MC})	0.06*	0.05*
Random effects (variances and covariances)			
σ^2_{csv1}	σ^2_{msv1}	1.03*	0.39
$csv_1 \leftrightarrow msv_1$		0.15*	
Fit statistics			
χ^2 (*df*)		1200.90 (776)	
RMSEA		0.03	
CFI		0.96	
SRMR		0.16	

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; csv_1, latent intercept for child sports value; msv_1, latent intercept for mother sports value; Δcsv[t] latent change factor for child sports value at time t; Δmsv[t] latent change factor for mother sports value at time t.
*$p < .05$.

not converge despite numerous attempts to diagnose the issue through model alterations. As previously discussed, the model's inability to converge could be due to a number of issues. However, the most plausible explanation is that models with random effects that have small variances are prone to convergence issues (Muthén & Muthén, 1998–2012). As shown in the univariate models (see Tables 6 and 7) all three groups—mothers in particular—had average yearly change scores that exhibited very little between-person variance. Combining this issue with the model itself being highly computationally complex could have prevented convergence. Despite not being able to successfully construct a multivariate model that shows the effect of one parent above and beyond the effect of the other parent, focusing on the parameters of the bivariate latent change score models is still of value when addressing the present study's research questions.

The fit statistics and parameter estimates for the bivariate model demonstrating the dynamic relations between mothers' and children's sports values are contained in Table 11. Results indicate that initial levels of children's and mothers' sports values were significantly related. As discussed previously, fit tests indicated that the dynamic relation between mothers' and children's sports value was best represented by a full coupling model in which mothers' sports value was a constrained leading indicator of subsequent changes in children's sports value ($msv \rightarrow \Delta csv$) and children's sports value also was a constrained leading indicator of subsequent changes in mothers' sports value ($csv \rightarrow \Delta msv$). The focus of the latent change score models are the change equations, so the change equations for the bivariate model of children's and mothers' sports value were

$$\Delta csv_{ti} = 6.35 + csv_{t-i} + .062 \cdot msv_{t-1i}$$

$$\Delta msv_{ti} = 4.22 + msv_{t-i} + .049 \cdot csv_{t-1i}$$

Because both of the coupling parameters are significant, we can consider both to be leading indicators for change in the other group. This following set of results address Research Questions 1.1 and 2.1 in more detail, exploring *how* reciprocal effects between parents' and children's values differed from year to year throughout the study period. The model shows that **mothers' sports value for their children significantly and positively predicted yearly change in their children's sports value from first to 11th grade**. As indicated by the univariate model of children's sports value, average changes in sports value were negative during those times. Thus, **higher levels of mothers' sports value for their children during first to ninth grade tended to slow the negative yearly change in children's sports value from first to 11th grade**.

Table 12

Parameter estimates and fit statistics for the bivariate latent change score model fit to children's and fathers' sports values

		Child Value	Father Value
Means (μ)			
μ_{csv1}	μ_{fsv1}	6.36*	4.58*
Dynamic parameters			
	fsv[t–1] → Δfsv[t] (β_F)		– 0.07*
	fsv[t–1] → Δfsv[t] (β_F*)		– 0.14*
fsv_1 → Δcsv_{12} (γ_{C12F1})	csv_1 → Δfsv_{12} (γ_{F12C1})	0.26*	0.00
fsv_2 → Δcsv_{23} (γ_{C23F2})	csv_2 → Δfsv_{23} (γ_{F23C2})	0.08	0.03
fsv_3 → Δcsv_{34} (γ_{C34F3})	csv_3 → Δfsv_{34} (γ_{F34C3})	0.02	0.06*
fsv_4 → Δcsv_{45} (γ_{C45F4})	csv_4 → Δfsv_{45} (γ_{F45C4})	– 0.14	0.001
fsv_5 → Δcsv_{56} (γ_{C56F5})	csv_5 → Δfsv_{56} (γ_{F56C5})	0.22*	0.05*
fsv_6 → Δcsv_{67} (γ_{C67F6})	csv_6 → Δfsv_{68} (γ_{F68C6})	0.01	0.17*
fsv_8 → Δcsv_{89} (γ_{C89F8})	csv_8 → Δfsv_{89} (γ_{F89C8})	0.21*	– 0.01
fsv_9 → Δcsv_{910} (γ_{C910F9})	csv_9 → Δfsv_{911} (γ_{F911C9})	– 0.07	0.11*
Random effects (variances and covariances)			
σ^2_{csv1}	σ^2_{fsv1}	1.03*	1.48*
csv_1 ↔ fsv_1		0.09	
Fit statistics			
χ^2 (*df*)		1288.43 (771)	
RMSEA		0.03	
CFI		0.95	
SRMR		0.18	

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; SRMR, Standardized Root Mean Residual; csv_1, latent intercept for child sports value; fsv_1, latent intercept for father sports value; Δcsv[t] latent change factor for child sports value at time t; Δfsv[t] latent change factor for father sports value at time t.
*$p < .05$.

Likewise, the model shows that **children's sports value significantly and positively predicted yearly change in mothers' sports value for their children from first to 11th grade**. As indicated by the univariate model of mothers' sports value for their children, none of the average yearly changes in value were significant. Therefore, I can only make a general interpretation of how these effects shaped mothers' sports value, which is that

higher levels of children's sports value tended to result in more positive yearly change in mothers' sports value for their children from first grade to 11th grade.

The model of children's sports value and fathers' sports value for their children showed a different dynamic change process when compared to the model of children's sports value and mothers' sports value for their children. The fit statistics and parameter estimates for the model are contained in Table 12. Results indicate that initial levels of children's and fathers' sports value were not significantly related. As discussed previously, fit tests indicated that the dynamic relation between fathers' and children's sports value was best represented by a full coupling model in which fathers' sports value was a freely estimated leading indicator of subsequent changes in children's sports value ($fsv \rightarrow \Delta csv$) and children's sports value also was a freely estimated leading indicator of subsequent changes in fathers' sports value ($csv \rightarrow \Delta fsv$). The focus of the latent change score models are the change equations, so the change equations for the bivariate model of children's and fathers' sports value were

$$\Delta csv_{ti} = 6.36 + csv_{t-i} + \gamma_{\mathrm{csv[t]\Delta fsv}[t]} \cdot fsv_{t-1i}$$

$$\Delta fsv_{ti} = 4.58 - .07 \cdot fsv_{t-i} + \gamma_{\mathrm{fsv[t]\Delta csv}[t]} \cdot csv_{t-1i}$$

Because both sets of coupling parameters were freely estimated, interpreting how they impact change can be fairly complex. However, there are some patterns that facilitate interpretation. The model shows that **fathers' sports value for their children significantly and positively**

predicted yearly change in children's sports value at three time points: Δcsv_{12}, Δcsv_{56}, and Δcsv_{89}. As indicated by the univariate model of children's sports value, average changes in sports value showed decreases during those times. Thus, **higher levels of fathers' sports value for their children in first grade, fifth grade, and eighth grade tended to slow the negative yearly change in children's sports value from first to second grade, from fifth to sixth grade, and from eighth to ninth grade.** Likewise, the model shows that **children's sports value also significantly and positively predicted yearly change in fathers' sports value for their children at four time points: Δfsv_{34}, Δfsv_{56}, Δfsv_{68}, and Δfsv_{911}**. Because models of proportional change do not estimate average yearly change, I can only make a general interpretation of how these effects shaped fathers' sports value, which is that **higher levels of children's sports value during third grade, fifth grade, sixth grade, and ninth grade tended to lead to more positive yearly change in fathers' sports value for their children from third to fourth grade, fifth to eighth grade, and ninth to 11th grade**. To summarize my findings in the sports domain both mothers' and fathers' sports values positively influenced change in children's sports value, and children's sports value positively influenced change in both their mothers' and fathers' sports values.

The final set of results to discuss are comparative effects sizes; first comparing effects of children's values versus parents' values, then comparing the effects of children's values on change in mothers' values versus change in fathers' values. Findings indicate that the reciprocal effects of children's and mothers' sports values were not significantly different in their magnitude ($\Delta\chi^2$ = 0.01, p > .05). Thus, mothers' and children's sports values had nearly identical impact on change in the other's values from first to 11th grade. By contrast, there were fewer overlapping significant effects of children's and fathers' values to compare. Results show that the reciprocal effects of children's and fathers' sports value were not significantly different in how they influenced change from fifth to sixth grade ($\Delta\chi^2$ = 0.17, p < .05). These effects also did not significantly differ from sixth to eighth grade ($\Delta\chi^2$ = 0.45, p > .05). However, reciprocal effects were significantly different in how they influenced change from eighth to ninth grade ($\Delta\chi^2$ = 0.76, p < .05), with fathers' math value having a significantly larger effect. Finally, a comparison of the effects of children's math value on change in fathers' versus mothers' value at the single time point in which both were significant, from sixth to eighth grade, indicated that these effects were not significantly different in their magnitude ($\Delta\chi^2$ = 0.07, p > .05).

Supplementary Analyses

Although not part of the primary investigation, I constructed two additional bivariate latent change score models to address Research Question 3, regarding whether children's perceptions of their parents' math and sports values predicted subsequent yearly change in children's own math and sports values from first to sixth grade. Further, these models addressed Research Question 3.1, regarding whether reciprocal effects between parents' and children's values differed in magnitude from year to year, in addition to Research Questions 3.2, regarding whether children's math and sports values predicted change in their perceptions of their parents' math and sports values from first to sixth grade. I excluded these two models from the primary investigation because all the information in these additional models was obtained from child reports. Thus, comparing these supplementary results to results from the primary analyses—which included information from both child reports and parent reports—would be comparing two different types of effects. However, I maintain the importance of conducting these analyses and discussing the findings within the context of the present study given that they test a fundamental tenet of Eccles' (1993) and Eccles (Parsons) et al.'s (1983) theory that the

Table 13

Fit statistics for supplementary univariate latent change score models fit to measures of children's perceptions of their parents' math and sports value

	Fit Statistics						
Model	χ^2	*df*	$\Delta\chi^2$	Δdf	CFI	RMSEA	SRMR
Perceived math value							
1. Basic change	3.26	2	–	–	0.99	0.03	0.07
2. Proportional change †	9.61	6	6.27	4	0.96	0.03	0.07
3. Dual change	29.86	8	20.25*	1	0.76	0.06	0.20
Perceived sports value							
1. Basic change	0.54	2	–	–	Just identified		0.11
2. Proportional change †	6.81	6	6.27	4	0.99	0.01	0.11
3. Dual change	36.86	7	30.05*	1	0.85	0.07	0.11

Note. χ^2, maximum likelihood chi-square; CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean residual.
† Denotes selected model.
**p* < .05.

socialization process operates through children's perceptions of their parents' beliefs and behaviors. The following sections describe the process by which I constructed and tested the two supplementary models, which parallel the processes undertaken in the construction of the primary models.

I followed the same process to construct and test these models that I used to address Research Questions 1 and 2. I first developed measurement models to test for measurement invariance in children's perceptions of their parents' math and sports value across the six time points; both models converged successfully. However, because these models consisted of single-indicator factors, no fit statistics (e.g., χ^2, AIC, RMSEA) were produced to evaluate the extent to which child perception models met full scalar invariance. I then fit univariate models to the data in order to determine the most appropriate model of change for children's perceptions of their parents' valuing of math and sports. According to the model fit comparisons (the full set of fit statistics are shown in Table 13), the proportional change model best captured longitudinal

Table 14

Parameter estimates for the chosen supplementary univariate latent change score model fit to children's perceptions of their parents' math and sports values

		Math	Sports
Means (μ)			
μ_{pmv1}	μ_{psv1}	6.46*	5.66*
Dynamic parameters			
pmv[t–1] → Δpmv[t] (β_{PM})	psv[t–1] → Δpsv[t] (β_{PS})	– 0.01*	– 0.04*
Random effects (variances and covariances)			
σ^2_{pmv1}	σ^2_{psv1}	0.90*	1.73*
$\sigma_{\Delta pmv12}$	$\sigma_{\Delta psv12}$	1.11*	2.27*
$\sigma_{\Delta pmv23}$	$\sigma_{\Delta psv23}$	1.49*	1.93*
$\sigma_{\Delta pmv34}$	$\sigma_{\Delta psv34}$	0.83*	0.42
$\sigma_{\Delta pmv45}$	$\sigma_{\Delta psv45}$	0.60*	0.95*
$\sigma_{\Delta pmv56}$	$\sigma_{\Delta psv56}$	0.12	0.39
pmv_1 ↔ Δpmv_{12}	psv_1 ↔ Δpsv_{12}	– 0.56*	– 1.21*

Notes. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; psv_1, latent intercept for children's perceptions of their parents' sports value; Δpmv[t] latent change factor for children's perceptions of their parents' math value at time t; Δpsv[t] latent change factor for children's perceptions of their parents' sports value at time t.
*p < .05.

changes in children's perceptions of their parents' math ($\Delta\chi^2$ (1) = 20.25, CFI = 0.96, RMSEA = .03) and sports values ($\Delta\chi^2$ (1) = 30.05, CFI = 0.99, RMSEA = .01).

The parameter estimates for the univariate model of children's perceptions of their parents' math value (shown in Table 14) indicate that children perceived their parents to hold an average math value of 6.46 while children were in first grade. Estimates also show that there was significant variation in the level of perceived parental math value at grade 1 (σ^2_{pmv1} = 0.90, p < .01) and significant variation in yearly changes from first to fifth grade. The proportional change parameter for children's perceptions of their parents' math value was significant and negative

(β_{PM} = – 0.01, p < .001), indicating a slowing in growth with respect to higher levels of initial perceived math value, or a regression to the mean effect.

The parameter estimates for the univariate model of children's perceptions of their parents' sports value (also shown in Table 14) indicate that children perceived their parents to hold an average sports value of 5.66 while children were in first grade. Estimates also show that there was significant variation in the level of perceived parental sports value at grade 1 (σ^2_{psv1} = 1.73, p < .001) and significant variation in yearly changes from first to third grade and again from fourth to fifth grade. The proportional change parameter for children's perceptions of their parents' sports value was significant and negative (β_{PS} = – 0.04, p < .001), indicating a slowing in growth with respect to higher levels of initial perceived sports value, or a regression to the mean effect.

I then fit a series of bivariate latent change score models to address Research Questions 3, 3.1, and 3.2, regarding not only whether there are reciprocal effects between children's own values and children's perceptions of their parents' values but also if these effects differ in magnitude from year to year from first to sixth grade. Table 15 contains fit information for both series of tests conducted on two bivariate latent change score models. Convergence issues were encountered multiple times throughout the testing process with regard to the sports models; these models were eliminated as options.

For the bivariate model of children's perceptions of their parents' math value and children's own math value, fit tests indicated that a constrained bidirectional coupling model best represented the dynamic relation between the two constructs ($\Delta\chi^2(4)$ = 12.61, p < .01). Thus, children's math value was a constrained leading indicator of subsequent changes in children's perceptions of their parents' math value ($cmv \rightarrow \Delta pmv$) and children's perceptions of their parents' math value also was a constrained leading indicator of subsequent changes in children's math value ($pmv \rightarrow \Delta cmv$). Thus, confirming my hypothesis for Research Question 3 that children's perceptions of their parents' math value would predict change in children's own value, **children's perceptions of their parents' math value was found to be a significant predictor of subsequent changes in children's own valuing of math, of which the effects did not vary across the study period.** These results, however, did not confirm my hypotheses for Research Question 3.1 that these effects could vary across the study period. Further, confirming my hypotheses for Research Question 3.2 that children's own value would predict change in children's perceptions of their parents' value, **children's own math value was found to be a significant predictor of subsequent changes in children's perceptions of their parents' math value, of which the effects did not vary across the study period**.

For the bivariate model of children's perceptions of their parents' sports value (*psv*) and children's own sports value, issues with non-convergence resulted in the removal of the covariances between the consecutive change scores for children's perceptions of their parents' sports value. Fit tests indicated that a constrained unidirectional coupling model best represented the dynamic relation between the two constructs ($\Delta\chi^2(5) = 23.47$, $p < .001$). Specifically, children's perceptions of their parents' sports value was a constrained leading indicator of subsequent changes in children's own sports value ($psv \rightarrow \Delta csv$). Thus, confirming my hypothesis for Research Question 3 that children's perceptions of their parents' sports value would predict change in children's own sports value, **children's perceptions of their parents' sports value was found to be a significant predictor of subsequent changes in children's own valuing of sports, of which the effects did not vary across the study period.** These results, however, did not confirm my hypotheses for Research Question 3.1 that these effects

Table 15

Fit Statistics for supplementary bivariate latent change score models jointly fit to data on children's values and children's perceptions of their parents' values in (A) math and (B) sports

(A)		Constrained Coupling			Freely Estimated Coupling		
Fit Statistics	No Coupling	pmv$_{[t-1]}$ → Δcmv$_{[t]}$	cmv$_{[t-1]}$ → Δpmv$_{[t]}$	Full Coupling†	pmv$_{[t-1]}$ → Δcmv$_{[t]}$	cmv$_{[t-1]}$ → Δpmv$_{[t]}$	Full Coupling
χ2	447.62	442.77	440.58	430.16	429.76	430.79	426.49
df	211	210	210	206	206	206	201
Δχ2	–	4.85*	7.04*	12.61*	17.86*	16.83*	3.27
Δ*df*	–	1	1	4	5	5	5
(B)		Constrained Coupling			Freely Estimated Coupling		
	No Coupling	psv$_{[t-1]}$ → Δcsv$_{[t]}$†	csv$_{[t-1]}$ → Δpsv$_{[t]}$	Full Coupling	psv$_{[t-1]}$ → Δcsv$_{[t]}$	csv$_{[t-1]}$ → Δpsv$_{[t]}$	Full Coupling
χ2	630.44	606.97	NC	NC	598.97	NC	NC
df	218	213	NC	NC	209	NC	NC
Δχ2	–	23.47*	–	–	8.00	–	–
Δ*df*	–	5	–	–	4	–	–

Note. pmv, children's perceptions of parents' math value; cmv, children's math value; psv, children's perceptions of parents' sports value; csv, children's sports value; χ^2, maximum likelihood chi-square; NC, no convergence.
† Denotes selected model.
**p* < .05.

could vary across the study period. Further, in contrast to my hypotheses for Research Question 3.2 that children's own value would predict change in children's perceptions of their parents' value, **children's own sports value was not found to be a significant predictor of subsequent changes in children's perceptions of their parents' sports value.**

The fit statistics and parameter estimates demonstrating the dynamic relations between children's math values and children's perceptions of their parents' math values are contained in Table 16. Results indicate that initial levels of children's math value and children's perceptions of their parents' math value were significantly related. The focus of the latent change score models are the change equations, so the change equations for the bivariate model of children's and their perceptions of their parents' math values were

$$\Delta pmv_{ti} = 6.46 + 0.06 \cdot pmv_{t-i} - 0.09 \cdot cmv_{t-1i}$$

$$\Delta cmv_{ti} = 5.06 + cmv_{t-i} + 0.20 \cdot pmv_{t-1i}$$

Because both of the coupling parameters are significant, we can consider both to be leading indicators for change in the other construct. The following set of results address Research Questions 3.1 and 3.1 in more detail, exploring *how* reciprocal effects between children's own values and children's perceived parental values differed from year to year in the math domain. The model shows that **children's math value significantly and negatively predicted yearly change in children's perceptions of their parents' math value from first through sixth grade**. Because models of proportional change do not estimate average yearly change, I can only make a general interpretation of how these effects shaped children's perceptions of their parent' math value, which is that **higher levels of children's math value tended to lead to more negative yearly change in their perceptions of their parents' math**

Table 16

Parameter estimates and fit statistics for the supplementary bivariate latent change score model fit to children's math values and children's perceptions of parents' math values

		Child Value	Perceived Parent Value
Means (μ)			
μ_{cmv1}	μ_{pmv1}	5.06*	6.46*
Dynamic parameters			
	pmv[t–1] → Δpmv[t] (β_P)		0.06*
$pmv_{[t-1]}$ → $\Delta cmv_{[t]}$ (γ_{CP})	$cmv_{[t-1]}$ → $\Delta pmv_{[t]}$ (γ_{PC})	0.20*	– 0.09*
Random effects (variances and covariances)			
σ^2_{cmv1}	σ^2_{pmv1}	1.64*	0.45*
cmv_1 ↔ pmv_1		0.40*	
Fit statistics			
χ^2 (*df*)		430.17 (206)	
RMSEA		0.03	
CFI		0.92	
SRMR		0.10	

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; CFI, comparative fit index; SRMR, standardized root mean residual; cmv_1, latent intercept for child math value; pmv_1, latent intercept for children's perceptions of their parents' math value; Δcmv[t] latent change factor for children's math value at time t; Δpmv[t] latent change factor for children's perceptions of their parents' math value at time t.
**p* < .05.

values from first through sixth grade. By contrast, the model also shows that **children's perceptions of their parents' math value significantly and positively predicted yearly change in children's own math value from first through sixth grade**. As indicated by the univariate model of children's math value, average changes in math value showed decreases during those times. Thus, **higher levels of perceived parental math value tended to slow negative growth in children's math value from first to sixth grade**.

Table 17

Parameter estimates and fit statistics for the supplementary bivariate latent change score model fit to children's sports values and children's perceptions of parents' sports values

		Child Value	Perceived Parent Value
Means (μ)			
μ_{csv1}	μ_{psv1}	6.39*	5.78*
Dynamic Parameters			
	psv[t–1] → Δpsv[t] (β_P)		– 0.05*
$psv_{[t-1]} \rightarrow \Delta csv_{[t]}$ (γ_{CP})		0.08*	
Random effects (variances and covariances)			
σ^2_{csv1}	σ^2_{psv1}	0.79*	1.16*
$csv_1 \leftrightarrow psv_1$		0.64*	
Fit statistics			
χ^2 (*df*)		606.98 (213)	
RMSEA		0.04	
CFI		0.93	
SRMR		0.11	

Note. →, directive relationship/fixed effect; ↔, nondirective relationship/random effect such as a variance or covariance; χ^2, maximum likelihood chi-square; RMSEA, root mean square error of approximation; CFI, comparative fit index; SRMR, standardized root mean residual; csv_1, latent intercept for child sports value; psv_1, latent intercept for children's perceptions of their parents' sports value; Δcsv[t] latent change factor for children's sports value at time t; Δpsv[t] latent change factor for children's perceptions of their parents' sports value at time t.
*p < .05.

The fit statistics and parameter estimates demonstrating the dynamic relations between children's sports values and children's perceptions of their parents' sports values are contained in Table 17. Results indicate that initial levels of children's sports value and children's perceptions of their parents' sports value were significantly related. The focus of the latent change score models are the change equations, so the change equations for the bivariate model of children's and their perceptions of their parents' sports values were

$$\Delta csv_{ti} = 6.39 + cmv_{t-i} + 0.08 \cdot pmv_{t-1i}$$

$$\Delta psv_{ti} = 5.78 - 0.05 \cdot pmv_{t-i}$$

Because the univariate coupling parameter was significant, we can consider children's perceptions of their parents' sports value to be a leading indicator for change in children's own sports value. The following set of results address Research Questions 3.1 and 3.1 in more detail, exploring *how* reciprocal effects between children's own values and children's perceptions of their parents' values differed from year to year in the sports domain. The model shows that **children's perceptions of their parents' sports value significantly and positively predicted yearly change in children's own sports value from first through sixth grade**. As indicated by the univariate model of children's sports value, average changes in sports value showed decreases during those times. Thus, **higher levels of perceived parental sports value tended to slow negative growth in children's sports value from first to sixth grade**. To summarize my findings for the supplementary analyses, children's perceptions of their parents' values in math and sports consistently and positively influence change in children's own values from first to sixth grade. By contrast, children's own values consistently and negatively influenced change in children's perceptions of their parents' values in math. Children's sports value did not impact change in children's perceptions of their parents' values in sports.

Chapter 5: Discussion

Study Summary

The overarching goal of the present study was to assess three research questions (and sub-questions within each) concerning the dynamic relations of parents' and children's math and sports value in a sample of predominately middle class European American children. The first research question concerned how parents' self-reported values for their children predict subsequent yearly change in children's values in the domains of math and sports from first grade to 11th grade. While other studies have explored how parents' values relate to children's values at a given time point (e.g., Harackiewicz et al., 2012; Rozek et al., 2014; Simpkins et al., 2015), the present study is the first to investigate how parents' values influence change in their children's values from year to year. Additionally, I explored whether effects were consistent across time and how effects differed by parent gender. The second research question addressed how potential child-driven reciprocal effects predicted subsequent yearly change in parents' math and sports values for their children from first grade to 11th grade. Again, while other studies have explored bidirectional effects between parents' values and children's values at a given time point (e.g., Lazarides et al., 2017; Simpkins et al., 2015), the present study is the first to investigate how children's values influence change in parents' values for their children from year to year. Finally, the third research question (which was addressed in supplementary analyses) involved the examination of how children's perceptions of their parents' values and children's own values in math and sports reciprocally influence each other's yearly change from first to sixth grade. Although other studies have explored how children's perceptions of their parents' values influence children's own values in the math domain, no study to date has expanded this investigation to extracurricular domains, such as sports. Further, the present study is the first to investigate the dynamic relation between children's perceptions of their parents' values and children's own values. In this chapter, I will first discuss the results from the present study and integrate these results with the previous literature. I will then discuss the theoretical implications of my findings. Finally, I will discuss limitations of the present studies and ideas for future research to build on this work.

Summary of the Results

Overall, findings of the present study demonstrate the reciprocal influence of parents and their children on change in the other's values in math and sports and the additional impact of children's perceptions of their parents' values for change in children's own values. The key findings that I will discuss in his chapter are:

(a) Results concerning Research Question 1 showed that although mothers' and fathers' values significantly influenced change in children's sports value, mothers' value was not found to be a significant predictor of children's math value. Further, the influence of mothers' and fathers' values exhibited different patterns in the magnitude and consistency of their significant influence on change in children's sports value.

(b) Results relating to Research Question 2 indicate that children's values significantly influenced change in *both* their mothers' and fathers' values for their children in *both* math and sports. Further, the influence of children's values exhibited different patterns in the magnitude and consistency of their significant influence on change in mothers' versus fathers' values.

(c) Results regarding Research Question 3 showed that children's perceptions of their parents' values had consistent and significant positive effects on change in children's own values in both math and sports. By contrast, children's own values had a consistent and significant negative effect on change in their perceptions of their parents' values in math, but did not have an influence in sports.

Each of these key findings will be discussed in order in detail and with regard to how they compare to the hypotheses and prior literature.

Influence of Mothers' and Fathers' Self-Reported Values

Results from the present study are, in many respects, consistent with prior research that parents' task values influence the task values of their children (e.g., Bois et al., 2002; Eccles, 2007; Gniewosz & Noack, 2012b; Lazarides et al., 2015). With respect to Research Question 1, the present study's findings parallel my hypothesis and show that, in most instances, parents' values predicted subsequent change in children's valuing of math and sports. Fathers' math value for their children significantly predicted subsequent changes in children's math value and both mothers' and fathers' sports values for their children significantly predicted subsequent changes in children's sports value. These results support the proposed links between the task values of parents and their children in Eccles' (Eccles, 1993; Eccles & Wigfield, 2020; Eccles [Parsons] et al., 1983) theoretical model, which highlights parents' roles as important socializers of children's task values. This study is the first to demonstrate these linkages between both mothers and fathers and their children in the domain of sports.

Interestingly, these findings differ from the results presented by Simpkins and colleagues (2015)—who used the same dataset as the present study—who suggested that parents' valuing of math and sports for their children did not significantly influence children's values in those domains. As I noted in Chapter 3, these differences in findings may be accounted for by the different analytical methods utilized in the present study, particularly my focus on change. Instead of examining how parents' and children's values relate at the same time point or, as in

Simpkins et al., how parents' values impact children's values at a later time point, the present study examined how the values of one group influences the subsequent yearly change in values of the other group. Further, the present study grouped children by age to examine effects on yearly change from first to 11th grade and model change incrementally so that predictive effects could vary across developmental periods. By contrast, Simpkins et al. (2015) grouped children of different ages into waves, which could have obscured some of the effects found in the present study.

One result regarding relations of parents and their children's task value did not support my hypotheses: Mothers' math value for their children did not emerge as a significant leading indicator of change in children's math value. Although contrary to what I expected, this result is nonetheless supported by some prior evidence indicating that mothers' math value was not related to and did not predict children's math value (e.g., Eccles et al., 1982; Frenzel et al., 2010; Jacobs & Bleeker, 2004; Simpkins et al., 2015). One important difference to consider when comparing this set of results to those from the present study is that the prior studies found neither mothers' *nor* fathers' math values to be influential for their children's own values. However, the present study did find fathers' math value to be a significant predictor of change in children's own math values, so why was mothers' math value specifically uninfluential on children's math values in the present study?

One plausible explanation for this unexpected result is that mothers' math value may only have significant effects on change in the math values of either their sons or their daughters, but not both. For example, Gniewosz and Noack (2012a) found that German mothers' math values had significant and unique positive effects on their fifth-grade children's valuing of math over a year later, but were more likely to impact the math value of their daughters over their sons.

However, because I was unable to expand the investigation to explore differences in effects by parent *and* child gender, these specific child gender effects would go undetected in the present study. Another potential explanation could be that children may have viewed fathers as a better role model for math based on gender-role stereotypes. That is, children may have perceived fathers, who are stereotyped to be better at math (Brandell & Staberg, 2008), as particularly important influencers within that domain when compared to their mothers (Leaper et al., 2012; Viljaranta et al., 2015). If children believe fathers to hold more math ability or use math more at home or work, they may turn to them more frequently for help with math-related tasks and discuss the value of math during those interactions. Fathers' stereotyped high math ability may be particularly important with regard to whom children turn to for help when math tasks become more difficult in middle and high school. By contrast, mothers may be seen as having stereotypically low math ability, and thus children may not instinctually go to them for math help, thus leaving mothers with little time to directly and clearly communicate their valuing of math for their child during these activities.

Differences in Influence Across Time and Between Parents

By utilizing more complex modeling methods to investigate the dynamic relation between parents' and children's values, the present study was able to identify distinctions in how parents shape their children's valuing of math and sports. Specifically, I was able to explore how the predictive effects of parents' values for their children on change in children's values differed not only across time (addressing Research Question 1.1) but also between mothers and fathers (addressing Research Question 1.2).

Focusing on the impact of fathers' math value for their children, although it significantly predicted yearly change in children's math value, these effects varied in significance, magnitude, and valence across the timespan of the study. Specifically, fathers' math value for their children positively influenced change in children's math value from fourth to fifth grade and from eighth to ninth grade, but had a negative influence from sixth to seventh grade and from ninth to tenth grade. The impact of fathers' sports value for their children on change in children's sports value was similar. These effects varied in significance and in magnitude across the time period, however, the effects of fathers' sports value maintained a positive valence. Specifically, fathers' sports value for their children positively influenced change in children's sports value from first to second grade, from fifth to sixth grade, and from eighth to ninth grade. In distinct contrast with the impact of fathers' values in both domains, mothers' sports value for their children was found to be a consistently significant and positive influence on change in children's sports value from first through 11th grade.

I presented the results of both parents' math and sports values in tandem to highlight several important patterns that not only address my hypotheses pertaining to Research Questions 1.1 and 1.2, but also suggest *how* mothers and fathers distinctively impact change in children's values. First, the influence of mothers' sports value for their children on change in children's sports value was consistent (i.e., coupling parameters were constrained across time) and reasonably small in magnitude. By contrast, the impact of fathers' values for their children in both math and sports domains were not consistent across time, with significant effects scattered throughout the study period. However, these effects are much larger when compared to the impact of mothers' value.

This pattern of effects directly addresses my hypothesis for Research Question 1.1, in which I had predicted that the magnitude of the impact of parents' values for their children on change in children's values would wane over time. This hypothesis was based on prior research showing that parents' influence on children's academic and sports choices and motivation decreases as children enter adolescence (Anderssen et al., 2006; Brown, 2004; Fredricks & Eccles, 2004). However, the results of the present study clearly did not reflect this hypothesized trend in any model. My findings instead suggest that the role parents have in the socialization of their children's values are much more complex than prior evidence suggests. This pattern of effects also confirmed my hypothesis for Research Question 1.2, in which I projected that there would be a differential impact between mothers' and fathers' values on change in children's task values in math and sports. These results complement the literature showing differences in the socialization practices of mothers and fathers and how these differences uniquely contribute to children's development (Cabrera et al., 2014; Cabrera, et al., 2007; Grusec & Davidov, 2010). And, in particular, these findings are consistent with other studies on parental socialization of task values showing that mothers' and fathers' math values uniquely contributed to middle school and high school children's own math value (Gladstone et al., 2018).

Examining the pattern of effects for sports, the influence of mothers' value is more stable and consistent over time. Perhaps this is because many mothers have greater involvement in their children's lives from early infancy through adolescence when compared to fathers (Hofferth et al., 2007; Phares et al., 2009; Pleck & Masciadrelli, 2004). Thus, children may be more consistently exposed to their mothers' valuing of sports for their children through communication of mothers' values during more frequent interactions than they are exposed to their fathers' values.

By contrast, although fathers' sports values were not consistently influential for change in children's values, my findings indicate that they were extremely impactful during educational transitions. Specifically, fathers' sports value for their children significantly predicted change in children's sports value at the beginning of the study period (i.e., upon entry into formal schooling), from fifth to sixth grade (i.e., transition into middle school), and from eighth to ninth grade (i.e., transition into high school). This pattern is not as formally demarcated for math. Fathers' math value for their children influenced change in children's values at the conclusion of elementary school (i.e., from fourth to fifth grade), and then throughout the time when children are in middle school and into high school (i.e., sixth through tenth grade). However, consistent with the pattern established by fathers' influence in the sports domain, the strongest effect was that which occurred when children were transitioning to high school (i.e., from eighth to ninth grade). This study is the first to date to illustrate how mothers' and fathers' task values uniquely shape children's task values and the first to suggest that fathers' values are particularly influential during educational transitions. Potential explanations for these results are addressed in the following section.

How Parents' Values Impact Change in Children's Values

A significant benefit of using latent change score modeling to address the dynamic relations between multiple constructs is that one can identify not just whether the value of one construct has an impact on subsequent change in another construct, but *how* levels of one construct shape the trajectory of the other construct. My findings show that both mothers' and fathers' sports values for their children had solely positive effects on yearly change in children's sports value which, as indicated by the univariate model of children's sports value, were negative. The important implication of this positive effect is that it shows that higher levels of parental sports value, in fact, slowed the negative change trajectory in children's sports value that was depicted by Jacobs et al. (2002). During elementary school, children are greatly interested in and participate in a variety of in sports activities (Wigfield et al., 1997). However, as children get older, sports activities become more selective and comparative. Given that children's task values and perceptions of competence are linked (Deci & Ryan, 1985; Eccles et al., 1983; Jacobs et al., 2002), the child who was the best soccer player in their elementary school may feel less skilled—and thus, value the sport less—after playing soccer with a more skilled and competitive group of children in middle school. If the child sits on the bench for some time in middle school, they may exhibit further decline in value and competence and decide not to try out for the team in high school (Jacobs et al., 2002). Thus, it is possible that parents' communication of their sports value serves to reinforce some of the value children are at risk to lose as children encounter higher skill standards. Mothers may provide constant communication of sports value to maintain children's continued interest and participation in these activities even when it becomes evident that they are less skilled. Likewise, communication of fathers' values may provide additional support to children's wavering sports values during times of educational transition when the normative skill level and competition of their peers dramatically increases. Fathers' sports value may be particularly influential during transitions when compared to that of mothers because of the stereotypes denoting fathers as possessing more sports ability (Brandell & Staberg, 2008). By contrast, fathers also may communicate their sports value more assertively to their children when children experience the competition associated with educational transitions so that they may overcome those barriers to continued sports valuing and participation.

The positive impact of parents' values was not limited to sports. Findings indicate that higher levels of fathers' math value for their children at several time points also slowed the negative change trajectory in children's math value (e.g., Jacobs et al., 2002), particularly during the transition from middle school to high school. Paralleling children's experience in the domain of sports, children often have inflated perceptions of math competence during the elementary years (Wigfield et al., 1997), only to encounter higher academic standards (e.g., Eccles & Midgley, 1989) and other equally talented students upon the transition to middle school and again when transitioning to high school. Accompanying the negative change in math competence that occurs when children experience these difficult educational transitions is the negative change in their math value. For this domain, fathers' value may play a larger role as children get older if they are the parent children turn to more frequently for assistance with more difficult math homework (Hyde et al., 2006). Thus, fathers may have more opportunity to communicate the importance of math to their children during these interactions as a means of encouraging them to persist through difficult, but academically imperative, math tasks.

However, I found that not all effects of parents' values on change in children's values were positive. Findings also show that fathers' math value for their children had negative effects on children's yearly change in math value scores while children were at the end of middle school and high school. Thus, higher levels of fathers' math value for their children led to greater negative change in children's math value during those times. This result suggests that fathers, in fact, contributed to the downward trajectory of children's math value at certain times while suppressing downward change at other times. This result is surprising, as most prior studies that relate parents' values to their children's values have shown primarily positive effects (Harackiewicz et al., 2012; Gniewosz & Noack, 2012b; Hyde et al., 2016). However, it is possible that higher levels of parental math value may not always be communicated or result in behaviors that serve to increase children's own math value. For example, Gniewosz & Noack (2012b) found that the more parents valued math while their children were in middle school, the more involved parents reported to be in math activities with their children. Although researchers have widely documented the benefits of active parental involvement with children's schoolwork (e.g., Archer et al., 2012), some evidence suggests that too much parental involvement—or involvement that can be described as controlling—can be detrimental to children's interest and enjoyment of academic activities (see Grolnick et al., 2009). If children do not see math as interesting or relevant to their lives, it is possible that the heightened pressure from fathers' communicated math value may exacerbate the negative change in value children exhibit during these times. The following section will turn to how children's values influence change in the values of their parents.

Influence of Children's Values on Their Parents Values

Research Question 2 was posed to test Eccles' (Eccles, 1993; Eccles & Wigfield, 2020; Eccles [Parsons] et al., 1983) assumption—and my hypothesis—that parents' beliefs and values for their children are shaped by children's own beliefs and valuing of specific domains. The findings show that children's values significantly predicted subsequent changes in *both* mothers' and fathers' values for their children in *both* math and sports domains. Although these results support the theorized relations proposed by Eccles and her colleagues, they also differ from the findings of Simpkins et al. (2015) who suggested that children's valuing of math and sports did not significantly influence parents' values for their children in those domains. In the previous section, I discussed the various methodological differences between our two studies that likely contributed to divergent findings regarding the influence of parents' values for their children. These methodological differences are likely contributors to conflicting findings with regard to the influence of children's values as well.

Differences in Influence Across Time and Between Parents

The results of the present study identified differences in how children's values shape their parents' values from first to 11th grade. Specifically, findings confirmed my hypotheses that the predictive effects of children's values on change in parents' values for their children differed not only across time (addressing Research Question 2.1) but also between mothers and fathers (addressing Research Question 2.2) in both math and sports domains.

Although I found children's math value to significantly predict subsequent change in both parents' math values for their children, these effects varied in significance, magnitude, and valence across the timespan of the study. Further, there were differences in the pattern of how children's math values predicted change in their mothers' versus their fathers' values. Specifically, children's math value negatively influenced change in mothers' math value for their children from sixth to eighth grade, but positively influenced change from ninth to 11th grade. The impact of children's math value on change in fathers' math value was similar. Children's math value negatively influenced change in fathers' math value from fifth to eighth grade, but positively influenced change from eighth to ninth grade.

These findings illustrate the important role of children's values in shaping parents' values for their children. First, although the influences of children's math value are both negative and positive, the negative effects primarily impact change in parents' math value during middle school whereas the positive effects primarily impact change in parents' math value during high school. One possible explanation for why children's math value has primarily negative effects from fifth to eighth grade is because middle school can represent a challenging developmental stage for children. Eccles and colleagues (1997) suggest that middle school is a period defined by poor stage-environment fit (Eccles & Midgley, 1989)—or a mismatch between developing adolescents' needs and the opportunities offered to them in their educational environments both socially and academically—which has negative consequences for children's academic motivation during those years. Difficulties in academic domains, such as math, could result in children's communicating low valuing of those domains to their parents. Thus, parents' valuing of math for their children also may drop in response to their children's negatively-focusing communication surrounding that domain. By contrast, in high school children may have become more comfortable with their surrounding educational environment and a better idea of how they value different academic domains. Thus, if children are more secure in their values at this time, they also may be more assertive in expressing to their parents which domains they value more positively.

Second, my findings in the math domain suggest that the influence of children's values on change in mothers' values lags behind the influence children's values have on change in fathers' values. In both middle school and high school, the effects of children' math value significantly impact change in their fathers' math value first, with change in mothers' math value not significantly shaped by children's math value until the following year. The present study is the first study to identify this pattern of effects. There are a few potential explanations for this phenomenon. As discussed previously, this could be due to children having more math-focused interactions with their fathers than their mothers in middle school and high school. Thus, children's math value may influence change in their fathers' values first. Another explanation is that this delay in children's influence on fathers' versus mothers' change is due to an unmodeled relation between mothers' and fathers' value. The present study found that measures of mothers' and fathers' math value showed weak to moderate positive correlations, which supports prior findings suggesting that although parents' values share some common variance, they are far from identical (Frome & Eccles, 1998; Gladstone et al., 2018). However, no studies to date have explored whether the values of one parent may influence change in the values of another parent. It is possible that, in addition to children, fathers also play a role in shaping the values of mothers; and it may actually be fathers that influence mothers to align more with their own math values, acting as a mediator of the relation between children's math value and change in mothers' value. Future investigations also should add paths to the models presented in the current study to explore how parents' influence each other's change in different domains to further elucidate how not just the values of children but the values of a family develop over time. Likewise, studies also should replicate these relations in domains that are stereotyped as more female (e.g., English, music), in which mothers are more influential (Leaper et al., 2012; Viljaranta et al., 2015) to investigate whether this pattern of effects reverses. Perhaps children's values would significantly influence change in mothers' values prior to change in fathers' values.

The influence of children's sports value shows some parallels to the impact children's value had in the math domain. Children's sports value significantly predicted subsequent change in both mothers' and fathers' sports value for their children. While these effects varied in significance and magnitude, they did not vary in valence across the timespan of the study. Further, there were differences in the pattern of predictive effects between parents. Specifically, children's sports value positively influenced change in both mothers' and fathers' math value for their children. The effects on change in mothers' sports value were small in magnitude but consistently significant from first to 11th grade. By contrast, the effects on change in fathers' sports value were almost double in magnitude when compared to their effect on mothers' value, particularly during the high school years. However, these effects also were inconsistent, with significant effects on change contained within the middle and high school years.

This pattern of results in the sports domain suggests that the dynamic relation between children's and parents' sports value is not just reciprocal as was proposed by Eccles and her colleagues (Eccles [Parsons] et al., 1983; Eccles, 1993), but also that children and parents show similarities in how they influence each other. The effects that children's sports value have on change in mothers' sports value mirrors the influence of mothers' own values for their children. The same can be said for the effects between children's and fathers' sports value. These interpretations of the results are supported by comparisons of the magnitude of reciprocal effects of children's and parents' sports values. While the effects of fathers' and children's sports values were not statistically different, the effects of mothers' and children's sports values were nearly identical.

This parallel nature of reciprocal influence regarding the value of sports may be explained by the different patterns of interactions mothers and fathers have with their children. While children may interact more consistently with mothers, they may turn to and interact more with fathers when they need assistance in that domain. While I discussed in the previous section how these patterns facilitate different opportunities for mothers and fathers to shape children's values, what is illustrated in these latest results is that these opportunities also open up the possibility for children to shape their parents' values during these interactions as well. By consequence, the reciprocal effects between parents and children may take on the same qualities with regard to consistency and magnitude. These are findings that, to my knowledge, no other study has produced, but potentially clarifies how reciprocal parent-child socialization of task value occurs within Eccles' (1993) parental socialization model. Future research should replicate this investigation in other academic and extracurricular domains to see if findings reproduce these patterns.

How Children's Values Impact Change in Parents' Values

The longitudinal design of the CAB study allowed me to assess how children's values influenced change in parents' value trajectories. However, because parents' univariate models indicated that yearly changes in both mothers' and fathers' values were nonsignificant—with the exception of change in mothers' math value during elementary school and high school—I am limited to primarily general interpretations of the impact of children's values on parents' change in values rather than having the ability to illustrate how effects alter the particular trajectory of parents' change in value.

Focusing first on the positive effects, findings show that children's sports value had exclusively positive effects on yearly change in both mothers' and fathers' sports value for their children. Thus, higher levels of children's sports value tended to result in more positive yearly change in both mothers' and fathers' sports value for their children during the timespan of the study. The same positive effects can be found in the math domain, in which higher levels of children's math value tended to result in more positive yearly change in both mothers' and fathers' math value for their children during high school. Although changes in parents' valuing of math were mostly nonsignificant, mothers' valuing of sports for their children did decrease during high school. Thus, an important implication of these findings is that they show that higher levels of children's math value, in fact, slowed the negative change in mothers' math value during high school. I'll return to this finding later in this section.

Prior studies have found parents' and children's task values to relate positively (Harackiewicz et al., 2012; Gladstone et al., 2018; Gniewosz & Noack, 2012b; Hyde et al., 2016). Thus, it is not surprising to find that the more children express interest or their perceived importance of a domain, the more parents may alter their own attitudes to reflect the interests and pursuits of their children. Particularly for math, as discussed previously, children may be fairly certain regarding its value to them during high school and so may express more strongly to their parents that they perceive this domain to be important and interesting to them.

By contrast, during middle school children's math value related negatively to yearly changes in both mothers' and fathers' math value for their children. Although initially counterintuitive, higher levels of value could reflect the high sense of importance children express regarding math. However, if they perceive math to be highly important yet also experience difficulty with the more complex math tasks that start to take hold in middle school, parents may downplay their own valuing of math for their children in response. Returning to how children's math value slowed the negative change in mothers' math value during high school, it is possible that this finding again shows a delay in how mothers' value changes in response to their children's value. As noted before, future research should expand these investigations to include female-typed domains to see if these findings occur there as well.

Supplementary Analyses

As discussed earlier, I conducted supplementary analyses to explore Research Question 3, which concerned the dynamic relations between children's perceptions of their parents' math and sports values and children's own valuing of those domains. This decision to carry out this additional set of analyses is due to recent research that has shown the important role of children's perceptions of their parents' values in the value socialization process (e.g., Ahmed et al., 2010; Gniewosz & Noack, 2012b; Lazarides et al., 2017; Lazarides & Ittel, 2013).

Results of these analyses are mostly consistent with Eccles (1993) and Eccles (Parsons) et al. (1983) theoretical model and with prior research (e.g., Gniewosz & Noack, 2012b) showing that children's perceptions of their parents' values relate to children's own values. Broadly addressing Research Question 3 and paralleling my hypothesis, the present study found that children's perceptions of their parents valuing of math and sports significantly predicted subsequent change in children's own valuing of those domains from first through sixth grade. Although I hypothesized that these effects would wane over time (addressing Research Question 3.1), the effects of children's perceived parental values on yearly change in their own values were consistently significant and positive throughout the study period in both domains. Given that children had negative average trajectories in both math and sports value from first through sixth grade, the implication of these findings is that when they perceived their parents to hold higher values for each domain slowed the negative trajectory in children's math and sports value from first to sixth grade.

These results are similar to the effect of mothers' sports value on change in children's values. However, children's perceptions of their parents' values had significant impact on their valuing of both sports and math, not just sports. Further, when compared to the influence of parents' self-reported values for their children in math, these effects present the only steady influence on change in children's math value throughout the elementary school years in the present study. Taken together, these results suggest that that children's perceptions of their parents' values may be more consistent influencers on children's own values throughout childhood than are parents' self-reported values. In their theoretical model, Eccles (1993) and Eccles (Parsons) et al. (1983) emphasized that socialization processes operate through the individuals' perceptions of others' value expression. Likewise, work by Gniewosz and Noack (2012b) showed that children's perceptions of their parents' math values mediated the relation between parents' self-reported math values and children's own math value. Further, they found that parents' self-reported math values only weakly related to children's perceptions of their math value. One possible explanation for this disconnect is that the level of value parents report to hold for their children in a particular domain may not translate into the level of value that they communicate to their children. However, because children still perceived parents to value math and sports—given the significance of those effects—perhaps these perceptions simply didn't match the levels of value parents endorsed themselves. Clearly, future research needs to further explore a comparison of the impact of children's perceptions of parents' values to parents' self-reported values. Further, it would be of interest for future work to extend these comparisons from first to 12th grade.

I also examined how children's own values in math and sports predicted change in their perceptions of their parents' values. Addressing Research Question 3.2, while fit tests indicated that children's sports value was not a significant predictor, the present study found that children's math value significantly predicted subsequent change in children's perceptions of their parents' math value from first through sixth grade. More specifically, the effect of children's math value on yearly change in children's perceptions of their parents' math value was consistently significant and negative throughout the study period. The implication of these findings is that that higher levels of children's math value tended to lead to more negative yearly change in their perceptions of their parents' math values from first through sixth grade. This is a surprising and counterintuitive finding given that most children approach math tasks with an abundance of confidence in elementary school (Wigfield et al., 1997). This finding should be investigated further by additional research to explore potential interpretations for these effects.

An interesting observation when comparing results between the primary and supplementary analyses is the less prominent role children's own values play in the latter set of relations. The weaker effects of children's values in could be explained in part by common method variance. Variables tend to have a stronger correlation when they are reported by the same person (Podsakoff et al., 2003). Correlations between initial levels of children's values and children's perceptions of their parents' values were shown to be moderate in strength (r = 0.40–0.64), whereas correlations between initial levels of children's values and parents' values for their children were shown to be much weaker by comparison (r = – 0.01–0.16), Clearly, further research has to be conducted to examine whether these effects can be replicated.

Next, I will discuss the theoretical and practical implications of the present study.

Theoretical Implications

Findings from the present study mostly provide support for the links between parent and child beliefs in Eccles' (1993) and Eccles' (Parsons) et al. (1983) parental socialization model and expectancy-value theory more generally. In previous research, longitudinal relations between parents' and children's task values have been assessed in terms of how the value of one group predicts the value of another group at a later time point (e.g., Eccles et al., 1982; Gniewosz and Noack, 2012a; Harackiewicz et al., 2012; Jacobs & Bleeker, 2004; Lazarides & Ittel, 2013; Lazarides & Watt, 2017; Rozek et al., 2014; Simpkins et al. 2015). The present study built on this work by examining how each group's valuing of a domain predicts subsequent yearly change in the others' value of that domain and, in particular, reciprocity in these relations over time.

Importantly, however, findings from the present study also add nuance to the pathways between parents' valuing of different domains and children's own values proposed by Eccles' (1993) and Eccles (Parsons) et al.'s (1983) socialization model found in other studies (e.g., Bois et al., 2002; Eccles, 2007; Gniewosz & Noack, 2012b; Lazarides et al., 2015). Results showed that higher levels of parents' sports and math value for their children either slowed or accelerated the negative change trajectory in children's values in those domains at different points in the study period. Thus, parents' values contributed to the downward trajectory of children's math value at certain times while suppressing downward change at other times. While Eccles' (1993) and Eccles (Parsons) et al. (1983) had theorized the link between parents' and children's values, the present study's findings expand upon this link to help explain *how* parents' values shape the values of their children year by year.

More broadly, the present study's findings provide support for the premise contained in numerous parent-child socialization models that the processes involved are fluid and dynamic (Bell, 1968; Eccles & Wigfield, 2020; Lerner & Spanier, 1978). One of the most intriguing findings relevant to this point is that fathers were found to be particularly influential for change in children's values during educational transitions. These results illustrate the need for future work in this area to analyze the dynamic relations of motivational constructs in an incremental fashion by developmental stage if not year by year.

In further support of taking a dynamic perspective when investigating the socialization of task values are the present study's findings showing significant effects of children's value on change in both mothers' and fathers' value in both math and sports domains. These results support work by developmental theorists (Bell, 1968; Lerner & Spanier, 1978; Sameroff, 1975), that parent-child interactions can be understood as dynamic processes that are both parent- and child-driven (Kerr et al., 2010).

An especially interesting finding in the math domain suggests that the influence of children's values on change in mothers' values lags behind the influence children's values have on change in fathers' values in middle and high school. Again, this pattern could be due to the different types of interactions that mothers and fathers have with their children during this time.

However, no work to date has explored whether the values of one parent may influence the values—or changes in the values—of another parent. This question exposes a gap in Eccles' (1993) and Eccles (Parsons) et al.'s (1983) theoretical model, which neglects to address potential mother-father relations in beliefs and task values. Clearly, future work should explore these possibilities.

Finally, Eccles (Parsons) et al. (1983) emphasized that socialization processes operate through individuals' perceptions of others' value expression, such as encouraging a child to play sports or lecturing about the importance of math. Yet few studies, with the exception of Gniewosz and Noack (2012b), have explored this facet of her theory. Results addressing Research Question 3 indicated that children's perceptions do indeed significantly impact change in children's own values in both math and sports from first to sixth grade. Further, these effects, which were fixed across this portion of the study period, represented the only reliable influence on children's valuing of both math and sports during the elementary school years. Because children's perceptions of their parents' values and parents' self-reported values were not in the same model, I am unable to make a formal comparison of the two effects on change in children's values or determine if one effect is significant over and above the influence of the other effect. However, these results may serve to inform researchers of the value in including children's perceptions in future investigations of parent-child value socialization.

Practical Implications

In addition to theoretical implications, the present study's findings have some practical implications as well. Schools largely recognize that children experience difficulty during educational transitions and often incorporate additional programming into the final years of elementary, middle, and high school to help children adapt to the upcoming changes in their academic and social environment (Pallas, 2003). Because the present study showed fathers' math and sports values to have particularly strong and positive effects during educational transitions, perhaps schools and after-school programs can make special efforts to include fathers in transitional programs so that fathers can have additional opportunities to communicate their valuing of math and sports to their children. For example, schools can ask fathers to assist and partner with their children during elementary or middle school athletic field days. Schools also could address information describing math course options and potential coursework and career trajectories separately to mothers and fathers prior to registering for high school or even college courses to increase the chances that fathers will engage with their child about the value of math.

Additionally, my findings could inform existing intervention work focused on flattening the curve of children's declining math motivation throughout school. As I noted in Chapter 2, Harackiewicz et al. (2012) and Rozek et al. (2014) conducted comparable interventions to promote mothers' STEM utility value. They found that subsequent increases in mothers' STEM utility value directly related to an overall increase in children's future STEM value. If similar intervention work focused on the influence of fathers' values during educational transitions, perhaps these efforts may be even more effective in promoting children's math value than when focusing exclusively on the impact of mothers' values or the values of both parents.

Limitations

The present study was not without limitations, the first of which regards the dataset utilized in the present study. The results of this study need to be interpreted with consideration to several methodological decisions that impacted the nature of the CAB data. This study was based on a sample of primarily middle-class White families, whose children were of early elementary age in 1987. According to Simpkins et al. (2015), the socioeconomic homogeneity of the sample was a purposeful decision made by Eccles and her colleagues. They thought that in restricting the sample in specific ways, resulting research could test the processes by which parents influence their children's activity choices and motivational beliefs in families where income and neighborhood resources were not obstacles to supporting children's participation in both academic and extracurricular activities. Of course, this decision has implications for the generalizability of the present study's findings. It is important for future research to test whether these findings replicate across families of different socioeconomic, ethnic, cultural, and national groups in addition to families not composed of a cisgender mother and father pair. It is possible that the strength of these relations will vary across groups. For example, for families with fewer economic resources than those in the CAB dataset, both parents and children may value sports less because there are fewer opportunities for children to engage in sports activities.

Another limitation is that the data was collected from 1987 to 1995. Although I expect that the relations found in the present study will hold in more contemporary data, it is possible that cultural shifts that have taken place over the past 30 years might change the strength of some of the relations. For example, with the emergence of the STEM economy in the mid-2000s (National Academies of Science, 2005), policymakers, school systems, and the media began underscoring STEM skills as crucial for individual and national prosperity. Such developments may have resulted in increases in parents' and children's valuing of STEM domains, including math. In addition, changes in parental behaviors also may have impacted the pattern of results—particularly differences between mothers and fathers—observed in the present study. Recent data indicate that fathers in dual-earner couples spend nearly as many hours per week with their children (23.0 hours) as mothers do (26.5 hours), in contrast to 1981, when men in dual-earner couples spent only 17 hours per week with their children (Sandberg & Hofferth, 2001). Thus, it is important for future research to use data collected from different historical periods to explore how cultural shifts may impact the dynamic relation between parents' and children's values.

A final concern regarding the dataset itself is the presence of several gaps in data collection. Due to a break in grant funding, there is a three-year gap from wave 4 to wave 5. Consequently, only one cohort of children provided data during fifth, sixth, and seventh grade. In addition, researchers did not collect parent-response data during wave 5 while children were in seventh and 10th grade. Thus, the present study had to model two-year periods of change from sixth to eighth and from ninth to 11th grade.

The next set of limitations pertain to the challenges that occurred in the process of constructing and running the proposed latent change score models for the present study. As discussed throughout Chapters 4 and 5, convergence issues were a constant problem at various points of model development. Non-convergence prevented the present study from not only exploring the impact of mothers' and fathers' sports values in the same model but also the investigation of differences in effects by child gender. Unfortunately, it is difficult to ascertain the specific reason for non-convergence at the various points of model development in the present study. As noted previously, non-convergence is related to a multitude of issues ranging from random effects that have small variances, to the computational complexity of the proposed model, to estimating a model that is not appropriate for the data (Muthén & Muthén, 1998–2012). Regardless of the reason for why non-convergence occurred, it did leave a number of the questions posed by the present study unanswered. Given the present study's hypotheses that there would be differences in the impact of parents' values by parent-child gender dyad, it is possible that the patterns observed in the present study's findings would not replicate when exploring effects on boys and girls separately. Further, we still do not know if the significant impact of both mothers' and fathers' sports values would hold in a multivariate model that would control for the effects of the other parent. Future research with fewer missing data patterns may have more luck in addressing these important questions.

Future Directions

As discussed in this chapter, I believe the present study made critical empirical contributions to the current literature on the socialization of children's task value in the domains of math and sports. In particular, the present study showed that parents' and children's values reciprocally influence the change in other group's values in both math and sports domains. Results also indicated that there are differences in effects not only across time but between mothers' and fathers' values. However, there are still many unanswered questions that future research should address to replicate, extend, and build on this work.

The present study chose to focus on the domains of math and sports because both are typically perceived as male-typed domains and while sports is largely voluntary, math is, at least to a certain extent, educationally required and generally seen as necessary to academic success. However, by only testing the proposed relations in male-typed domains, the present study was unable to compare whether patterns of effects replicated in domains commonly stereotyped as more feminine (e.g., English) where mothers' values may be more influential (Leaper et al., 2012; Viljaranta et al., 2015). For example, it will be important for future work to attempt to replicate the delayed significant impact of children's math value on change in mothers' value versus fathers' value in more feminine-typed domains. Perhaps, a reverse pattern may be observed in a domain such as reading, where children might read books or go to the library more often with their mothers and thus result in significant effects on change in mothers' reading value occurring prior to a significant impact on change in fathers' value.

On a related note, I proposed that the delay in significant impact on change in mothers' versus fathers' math value also might reflect an underlying relation between mothers' and fathers' values that was not explored in the present study. Although prior work has found that parents' values share some common variance (Frome & Eccles, 1998; Gladstone et al., 2018), no studies to date have explored whether the values of one parent may influence change in the values of another parent. It is possible that, in addition to children, fathers also play a role in shaping the values of mothers, particularly in male-typed domains. Future work should add predictive paths between parents' values to the present study's models to explore how parents' influence each other's change in different domains to further elucidate how not just the values of children but the values of a family unit develop over time.

Due to convergence issues, the present study was unable to explore differences in effects by parent and child gender. Although the present study found a number of interesting differences in the impact of mothers' versus fathers' values, exploring further differences by child gender may expose even greater nuances to the dynamic relations between parents' and children's values. Perhaps future work utilizing data with fewer missing data patterns or more participants may have greater success in converging a model of such high computational complexity. It is also possible that by dividing the study to explore change within developmental or educational phases (e.g., elementary school), future work may find more success in these efforts.

The present study's findings appear to support the idea that children's perceptions of their parents' math and sports values may equally or even more dependably impact subsequent change in children's values—particularly during the elementary school years. However, because children's perceptions of their parents' values and parents' self-reported values were not in the same model, I could not formally compare the two effects on change in children's values or determine if one effect was significant over and above the influence of the other effect. It will be of interest for future work to expand the present study to compare the two effects from first to 12th grade. Researchers could expand upon the study by Gniewosz and Noack (2012b) in which children's perceptions of their parents' values are proposed to mediate the impact of parents' self-reported values on change in children's own values in a latent change score model.

Given that the present study was based on a sample of primarily middle-class White families composed of a mother and father in the United States, my findings present a very narrow view of parent socialization. Studies focusing on more diverse families in terms of ethnicity, nationality, family composition, and socioeconomic status are incredibly important to exploring whether these results replicate across different family contexts.

Conclusion

In the present study, I investigated the dynamic relation between parents' and children's values in math and sports. Specifically, I explored how the values of one group predict subsequent yearly change in the values of the other group. My findings primarily supported prior research and my hypotheses that parents and children's values reciprocally impact the other's change in both domains. Supplementary analyses further supported prior research and my hypotheses that children's perceptions also significantly predict subsequent yearly change in children's math and sports values. Results from the present study have important theoretical implications and expand our understanding of the socialization processes proposed by Eccles (1993) and Eccles (Parsons) et al. (1983) in their theoretical model. Future work should address some of the limitations of the present study and build on this work in order to further increase our knowledge of the dynamic socialization of task values across the school years.

Appendix A: Measures

Measure	Item
Children's math/sports value	How useful is what you learn in [math/sports]? (*1=Not useful, 7=Very useful*) For me being good in [math/sports] is (*1=Unimportant, 7=Important*) I find [working on math assignments/playing sports] (*1=Boring, 7=Interesting*) How much do you like [math/sports]? (*1=A little, 7=A lot*)
Parents' math/sports value for their child	How useful to do think [math/sports] will be to this child in the future? [a] (*1=Not at all useful, 7=Very useful*) How important is it to you that this child do well in [math/sports]? (*1=Not at all important, 7=Very important*)
Children's perceptions or their parents' math/sports value	How important is it to your parents that you do well in [math/sports]? (*1=Not at all important, 7=Very important*)

[a] Item was not assessed at wave 2.

Appendix B: Additional Tables

Table 18

Pearson correlation matrix among measures of children's, fathers', and mothers' math value

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1. CMV1	–																											
2. CMV2	**.81**	–																										
3. CMV3	**.82**	**.61**	–																									
4. CMV4	**.78**	**.58**	**.59**	–																								
5. CMV5	**.69**	**.54**	**.59**	**.54**	–																							
6. CMV6	**.71**	**.54**	**.57**	**.52**	**.66**	–																						
7. CMV7	**.63**	**.45**	**.45**	**.41**	**.50**	**.59**	–																					
8. CMV8	**.64**	**.46**	**.45**	**.41**	**.51**	**.60**	**.68**	–																				
9. CMV9	**.52**	**.41**	**.45**	**.41**	**.52**	**.53**	**.56**	**.66**	–																			
10. CMV10	**.48**	**.36**	**.38**	**.34**	**.43**	**.47**	**.52**	**.56**	**.86**	–																		
11. CMV11	**.43**	**.32**	**.33**	**.30**	**.38**	**.42**	**.46**	**.50**	**.72**	**.84**	–																	
12. FMV1	.00	.14	.21	.17	**.40**	.26	-.02	-.02	**.32**	.13	.11	–																
13. FMV2	.00	.14	.21	.17	**.41**	**.26**	-.02	-.02	**.32**	.13	.11	**1.0**	–															
14. FMV3	-.08	.05	.16	.12	**.36**	.21	-.06	-.06	**.29**	.10	.09	**1.0**	**1.0**	–														
15. FMV4	.00	.10	.25	.17	**.41**	**.26**	-.02	-.02	**.32**	.13	.11	**1.0**	**1.0**	**1.0**	–													
16. FMV5	.10	.17	**.32**	**.29**	**.46**	**.32**	.03	.03	**.36**	.17	.15	**.99**	**.99**	**.98**	**.99**	–												
17. FMV6	-.04	.07	.22	.20	**.29**	.21	-.07	-.07	**.28**	.09	.08	**.98**	**.98**	**.98**	**.99**	**.98**	–											
18. FMV8	-.34	-.16	-.03	-.02	.01	-.22	**-.32**	**-.33**	.06	-.11	-.10	**.87**	**.87**	**.89**	**.87**	**.84**	**.91**	–										
19. FMV9	.10	.16	**.28**	**.26**	**.36**	.19	.14	**.35**	**.50**	**.27**	**.24**	**.85**	**.85**	**.84**	**.85**	**.86**	**.85**	**.77**	–									
20. FMV11	.19	**.22**	**.33**	**.31**	**.42**	**.27**	**.23**	**.44**	**.64**	**.40**	**.35**	**.82**	**.82**	**.80**	**.82**	**.83**	**.81**	**.70**	**.99**	–								
21. MMV1	.05	.11	.16	**.16**	**.25**	**.22**	.12	.12	**.24**	**.17**	**.15**	**.37**	**.37**	**.37**	**.38**	**.38**	**.36**	**.27**	**.34**	**.35**	–							
22. MMV2	.04	.10	**.15**	**.15**	**.24**	**.21**	.11	.11	**.23**	**.17**	**.15**	**.38**	**.38**	**.37**	**.38**	**.38**	**.36**	**.27**	**.34**	**.35**	**1.0**	–						
23. MMV3	.03	.09	.14	**.14**	**.24**	**.20**	.10	.10	**.23**	**.16**	**.14**	**.37**	**.37**	**.37**	**.37**	**.38**	**.36**	**.28**	**.34**	**.35**	**1.0**	**1.0**	–					
24. MMV4	.02	.08	.13	**.13**	**.23**	**.19**	.09	.10	**.22**	**.16**	**.14**	**.37**	**.37**	**.37**	**.37**	**.38**	**.36**	**.28**	**.34**	**.34**	**1.0**	**1.0**	**1.0**	–				

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
25. MMV5	.01	.07	.12	.12	**.22**	**.19**	.09	.09	**.21**	**.15**	**.13**	**.37**	**.37**	**.37**	**.37**	**.37**	**.36**	**.28**	**.34**	**.34**	**1.0**	**1.0**	**1.0**	**1.0**	–				
26. MMV6	-.01	.06	.11	.11	**.20**	**.18**	.08	.08	**.21**	**.14**	**.13**	**.36**	**.36**	**.36**	**.36**	**.37**	**.35**	**.28**	**.33**	**.33**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	–			
27. MMV8	-.02	.05	.10	.10	**.19**	**.16**	.07	.07	**.20**	**.14**	**.12**	**.36**	**.36**	**.36**	**.36**	**.36**	**.35**	**.28**	**.33**	**.33**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	–		
28. MMV9	-.03	.05	.09	.09	**.18**	.15	.06	.05	**.19**	.13	.11	**.36**	**.36**	**.36**	**.36**	**.36**	**.35**	**.29**	**.32**	**.32**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	–	
29. MMV11	-.04	.04	.08	.09	.18	.14	.05	.04	.17	.11	.10	**.36**	**.36**	**.36**	**.36**	**.36**	**.35**	**.29**	**.31**	**.31**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	

Note. cmv, children's math value; fmv, fathers' math value; mmv, mothers' math value.
Bolded parameters are significant, $p < .05$.

Table 19

Pearson correlation matrix among measures of children's, fathers', and mothers' sports value

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1. CSV1	–																											
2. CSV2	**.72**	–																										
3. CSV3	**.66**	**.57**	–																									
4. CSV4	**.67**	**.58**	**.66**	–																								
5. CSV5	**.65**	**.57**	**.65**	**.78**	–																							
6. CSV6	**.60**	**.52**	**.58**	**.67**	**.70**	–																						
7. CSV7	**.66**	**.57**	**.64**	**.74**	**.77**	**.79**	–																					
8. CSV8	**.56**	**.48**	**.54**	**.62**	**.65**	**.66**	**.84**	–																				
9. CSV9	**.49**	**.43**	**.47**	**.55**	**.57**	**.59**	**.74**	**.87**	–																			
10. CSV10	**.54**	**.46**	**.51**	**.59**	**.61**	**.63**	**.79**	**.92**	**1.0**	–																		
11. CSV11	**.54**	**.46**	**.51**	**.59**	**.61**	**.63**	**.79**	**.91**	**.96**	**.91**	–																	
12. FSV1	**.45**	**.34**	**.33**	**.34**	**.27**	**.40**	**.45**	**.38**	**.34**	**.45**	**.45**	–																
13. FSV2	**.49**	**.37**	**.35**	**.37**	**.32**	**.41**	**.46**	**.39**	**.35**	**.44**	**.44**	**1.0**	–															
14. FSV3	**.44**	**.33**	**.31**	**.33**	**.27**	**.37**	**.42**	**.35**	**.32**	**.41**	**.41**	**.96**	**.78**	–														
15. FSV4	**.48**	**.36**	**.34**	**.36**	**.29**	**.42**	**.47**	**.40**	**.36**	**.47**	**.47**	**1.0**	**.85**	**.87**	–													
16. FSV5	**.40**	**.29**	**.26**	**.24**	.19	**.34**	**.39**	**.32**	**.29**	**.39**	**.39**	**1.0**	**.80**	**.83**	**1.0**	–												
17. FSV6	**.42**	**.32**	**.30**	**.30**	**.27**	**.37**	**.41**	**.34**	**.31**	**.43**	**.43**	**.93**	**.75**	**.77**	**.93**	**.85**	–											
18. FSV8	**.36**	**.27**	**.26**	**.25**	**.23**	**.31**	**.35**	**.29**	**.26**	**.40**	**.40**	**.79**	**.64**	**.66**	**.79**	**.72**	**.85**	–										
19. FSV9	**.38**	**.29**	**.27**	**.27**	**.25**	**.33**	**.37**	**.31**	**.28**	**.41**	**.41**	**.83**	**.67**	**.69**	**.84**	**.76**	**.90**	**1.0**	–									
20. FSV11	**.48**	**.37**	**.37**	**.39**	**.37**	**.45**	**.53**	**.50**	**.51**	**.64**	**.62**	**.88**	**.73**	**.74**	**.89**	**.80**	**.93**	**1.0**	**1.0**	–								
21. MSV1	**.28**	**.24**	**.25**	**.28**	**.28**	**.33**	**.39**	**.33**	**.31**	**.37**	**.37**	**.50**	**.54**	**.48**	**.52**	**.49**	**.47**	**.40**	**.42**	**.47**	–							
22. MSV2	**.26**	**.22**	**.24**	**.27**	**.26**	**.30**	**.35**	**.30**	**.28**	**.32**	**.32**	**.42**	**.46**	**.40**	**.44**	**.41**	**.39**	**.33**	**.35**	**.40**	**.82**	–						
23. MSV3	**.32**	**.29**	**.27**	**.31**	**.30**	**.35**	**.40**	**.34**	**.31**	**.36**	**.36**	**.47**	**.51**	**.45**	**.49**	**.45**	**.44**	**.37**	**.39**	**.45**	**.89**	**.72**	–					
24. MSV4	**.36**	**.32**	**.33**	**.34**	**.34**	**.38**	**.45**	**.38**	**.36**	**.41**	**.41**	**.48**	**.52**	**.46**	**.50**	**.46**	**.45**	**.38**	**.40**	**.47**	**.89**	**.72**	**.74**	–				
25. MSV5	**.35**	**.31**	**.33**	**.35**	**.34**	**.38**	**.44**	**.37**	**.35**	**.40**	**.39**	**.44**	**.48**	**.42**	**.46**	**.42**	**.41**	**.35**	**.37**	**.43**	**.79**	**.64**	**.66**	**.92**	–			
26. MSV6	**.38**	**.34**	**.36**	**.39**	**.39**	**.41**	**.48**	**.40**	**.37**	**.42**	**.42**	**.45**	**.49**	**.43**	**.47**	**.42**	**.42**	**.36**	**.38**	**.45**	**.80**	**.65**	**.67**	**.93**	**.77**	–		
27. MSV8	**.35**	**.31**	**.32**	**.35**	**.35**	**.37**	**.42**	**.36**	**.34**	**.39**	**.39**	**.41**	**.44**	**.39**	**.43**	**.38**	**.38**	**.32**	**.34**	**.41**	**.73**	**.59**	**.61**	**.84**	**.70**	**.63**	–	
28. MSV9	**.34**	**.30**	**.32**	**.35**	**.35**	**.37**	**.43**	**.38**	**.36**	**.40**	**.40**	**.39**	**.42**	**.37**	**.40**	**.36**	**.36**	**.31**	**.32**	**.39**	**.66**	**.54**	**.56**	**.77**	**.65**	**.59**	**.91**	–

29. MSV11	**.37**	**.33**	**.35**	**.38**	**.38**	**.40**	**.46**	**.41**	**.39**	**.43**	**.43**	**.42**	**.45**	**.40**	**.44**	**.39**	**.39**	**.33**	**.35**	**.43**	**.72**	**.59**	**.61**	**.83**	**.70**	**.63**	**.98**	**1.0**

Note. csv, children's sports value; fsv, fathers' sports value; msv, mothers' sports value.
Bolded parameters are significant, $p < .05$.

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